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THE ABILITY TO RECOGNIZE AND APPLY SCIENTIFIC PRINCIPLES IN NEW SITUATIONS

INFORMATION CONCERNING SCIENCE EDUCATION RESEARCH FOR 1949 AND 1950

COMMITTEE REPORTS:

Cooperative Committee
Educational Trends
Research in Problem-Solving in Science Teaching
Research in Elementary Science
Research in Secondary-School Science
Research in College Science
Atomic Energy Committee
Publications Committee

PROGRESS REPORT OF THE DEVELOPMENT OF TWELVE-YEAR SCIENCE CURRICULUM IN NEW YORK CITY SCHOOLS

MINUTES OF NATIONAL COUNCIL FOR ELEMENTARY SCIENCE

OFFICERS OF NATIONAL COUNCIL FOR ELEMENTARY SCIENCE

FINANCIAL REPORT OF NARST

PROGRAM OF TWENTY-FOURTH ANNUAL NARST MEETING

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College Station, Stillwater, Oklahoma

Manuscripts and books for review as well as all communications regarding advertising and subscriptions should be sent to the Editor.

SCIENCE EDUCATION: Published in February, March, April, October, and December.

Subscriptions $4.00 a year; foreign, $5.00. Single copies $1.00; $1.25 in foreign countries. Prices on back numbers furnished upon request.

Publication Office: 374 Broadway, Albany, New York.

Entered as second-class matter at the Post Office at Albany, New York, February 13, 1939, under the Act of March 3, 1879.

VOLUME 35 OCTOBER, 1951 NUMBER 4

CONTENTS

Increased Pupil Responsibility for Planning Learning Experiences..*W. W. E. Blanchet* 187
A Report to the NARST on the Activities for 1950–51 of the Cooperative Committee on the Teaching of Science and Mathematics of the AAAS..*George Griesen Mallinson* 189
Information Concerning Science Education Research 1949 and 1950..*Philip G. Johnson* 193
Progress Report of the Committee on Educational Trends.....*Elsa Marie Meder* 197
Progress Report of the Committee on Research in Problem-Solving in Science Teaching .....*J. Darrell Barnard* 200
Progress Report of the Committee on Research in Elementary Science....*N. E. Bingham* 201
Progress Report of the Committee on Research in College Science....*W. C. Van Deventer* 202
Progress Report of the Committee on Research in Secondary-School Science *Kenneth E. Anderson* 204
Progress Report of the Atomic Energy Committee..*Jerome Metzner and Abraham Raskin* 206
The Ability to Recognize and Apply Scientific Principles in New Situation *J. Harold Owens* 207
Progress Report of the Development of a Twelve-Year Science Curriculum in the New York City Schools.....*Alfred D. Beck* 214
Minutes of National Council for Elementary Science..... 215
Officers of National Council for Elementary Science..... 218
Report of the Publications Committee of NARST.....*Vaden W. Miles* 218
Financial Report of NARST.....*Clarence M. Pruitt* 218
Program of Twenty-Fourth Annual NARST Meeting..... 219
Official Minutes of Business Meeting of NARST.....*Clarence M. Pruitt* 219
Recently Elected Members of NARST..... 220
Book Reviews 221

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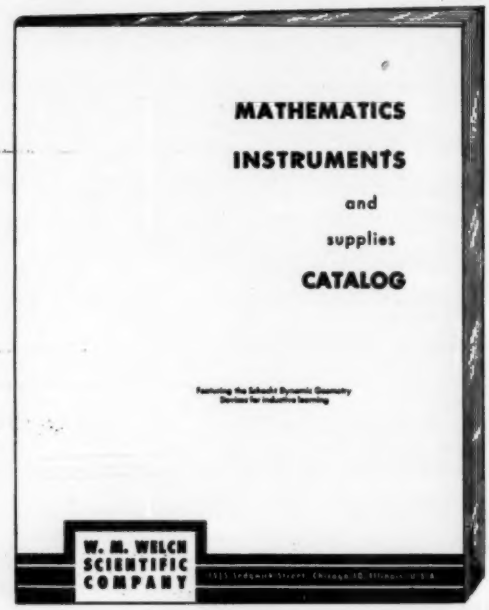

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SCIENCE EDUCATION

VOLUME 35 OCTOBER, 1951 NUMBER 4

INCREASED PUPIL RESPONSIBILITY FOR PLANNING LEARNING EXPERIENCES *

W. W. E. BLANCHET

The Fort Valley State College, Fort Valley, Georgia

IT is recognized that there is a trend toward increased pupil responsibility for planning learning experiences. No doubt that trend is based on the following assumptions:

1. That the student will select those learning experiences in which he has the greatest interest. From the point of view of the teacher, that interest is expected to help to motivate the student to put forth the maximum amount of effort.

2. That the student has a basis for value judgments that are sound and can be relied upon to plan those experiences that not only hold his interest, but that are also of value to him as an individual and as a member of a social group. Such an assumption is always open to question.

3. That the student will be as interested in all phases of a learning experience as he apparently is in the experience so named. For example, a group of students may select the "atom bomb" as a learning experience. They may be interested in the experience so named; yet, does it follow that they are equally as interested in the study of the electron, proton, neutron, radioactivity, alpha particles, gamma rays, isotopes, atomic structure, atomic weight, atomic number, etc., all of which enter into a study of the "atom bomb." I suppose it becomes the responsibility of the teacher to help the students to see that a study of these sub-topics is necessary for developing an understanding of the "atom bomb."

4. That group planning of learning experiences may have carry-over value for the student in everyday living.

Such a trend toward increased pupil responsibility for planning learning experiences would seem to have the following implications for science programs at the college level, particularly at the level of general education, usually placed in the first two years of college:

1. There can be no standardization of course content for general education science courses (not that I think that there should be standardized courses, but it is doubtful whether we can escape this implication).

2. Stress will have to be placed on the inculcation of scientific attitudes, facility in the use of the elements of the scientific method, widening interests, developing appreciations, and understanding whatever principles of science may be included in the experiences that the students select or assist in planning.

3. That techniques for student planning and evaluation of what to study and what has been studied will have to be developed.

a. In a study that I made in 1946 (*Science Education*, February, 1948, Vol. 32, No. 1, pp. 24–32) in which I asked students to evaluate topics that they had studied in survey courses in science, the conclusion was drawn that "the lack of agreement by the students with respect to which topics were valuable for inclusion in survey courses in science would seem to indicate that such opinions are of little value in selecting course content. The wide diversity of opinion may have been due to (1) the inability of such students to discriminate between topics of importance and those of relative unimportance; (2) the lack of a thorough digestion of the materials included in the course resulting from the inclusion of too much material in it; (3) the lack of proper perspective of teachers with respect to the course, which would enable them to stress the more important topics in their teaching; and (4) the remoteness of the course content from the activities and interests of the students. The data of the study, however, gave no indication of which, if any, of the four inferences is correct."

b. The study reported above did not deter me from attempting to get at and to make use of student participation in planning learning experiences. This year, in a not too refined study, I used the following approach to make

* Paper presented at the annual meeting of the National Association for Research in Science Teaching in Atlantic City, February 19, 1951.

use of student planning in terms of selecting learning experiences.

(1) Each member of a class of 70 students in a general education science course dealing with the physical sciences was asked to write on a piece of paper a question, the answers to which he hoped to find in the course in physical science.

(2) Those questions, or topics, were compiled into a rating sheet, mimeographed, and given to each student with the following directions:

Kindly rate the topics listed below for inclusion in the course in physical science. You should rate each topic in terms of the value of that topic in everyday living, and in terms of what you think an intelligent citizen should know. Write 1, 2, 3, 4, or 5 in the parentheses after each topic or question to indicate respectively, whether you consider that topic to be 1, not important; 2, relatively unimportant; 3, of average importance; 4, of considerable importance; 5, of greatest importance.

(3) An average rating for a question or topic was computed by multiplying a rating of 5 by the number of students so rating that topic, the rating of 4 by the number of students who gave the topic that rating, etc. All products were added and divided by the number of students who rated that topic. The procedure described was followed for each of the 63 questions or topics.

(4) The questions, or topics, were then arranged in descending order of average ratings.

We had already started on certain phases of astronomy before the tabulations were made and the averages computed. Since certain aspects of astronomy received high ratings, by agreement with the class the discussion on astronomy was continued. I examined the ratings for various items and picked out topics or questions that were related to astronomy and arranged them in descending order of their average ratings. The list of questions, or topics, follows:

TOPICS

	Average Rating
The earth's place in the universe....	3.97
Why is it that other heavenly bodies do not shine like the sun?.....	3.94
What holds the planets in space?....	3.74
Does the earth revolve and what makes it revolve (motions of the earth)?	3.61
What causes eclipses of the moon and the sun?.....	3.55
What is the effect of the planets on each other?	3.49
What is the cause of the seasons?..	3.47
Why do we have half moon and full moon (phases of the moon)?.....	3.36
How many planets the size of Mercury would be required to make a planet the size of the Earth?.....	3.22
Why is it that you can not see the sun move?	3.11
How may the diameter of the moon be measured?	3.09
Why is it night in some places and day in others?.....	3.01
Why do we have high and low tides?	2.98
What effect does the moon have on living animals?	2.97
What causes stars to twinkle and why some shine more brightly than others?	2.88
Why do stars fall and what causes the material to change before they strike the ground?	2.42

Particular stress was given to those topics that had values that placed them near the top of the above list. Some of the topics like the one with an average rating of 3.22 received little or no attention because in the opinion of the teacher not too much would be gained from making the calculations; likewise, no attention was given to the topic that had an average rating of 2.97. What causes stars to twinkle and why some shine more brightly than others was not treated, but may be later on.

The students were asked to suggest procedures for conducting the study and discussions of the various topics. I have tried to follow those suggestions. Most of them centered around reports by small groups on topics with the group leading the class discussions.

At present we are studying the atom bomb and what causes it. The specific topic is: "The Atom Bomb and What Causes It." That topic had an average rating of 4.22.

My question is whether the procedure that has been used is an acceptable way of implementing the trend toward increased pupil responsibility for planning learning experiences?

A REPORT TO THE NARST ON THE ACTIVITIES FOR 1950–51 OF THE COOPERATIVE COMMITTEE ON THE TEACHING OF SCIENCE AND MATHEMATICS OF THE AAAS *

GEORGE GREISEN MALLINSON

IT WAS decided in view of the extent of the activities of the Cooperative Committee during the year 1950–51, to report to the NARST in the same fashion as was done in 1949–50. Hence, the report will include (1) a brochure for each member that contains all the minutes, publications and activities of the Committee for the year 1950–51, and (2) this summary of the more important activities.

PERSONNEL OF THE COMMITTEE

A number of changes have taken place with respect to the personnel of the Committee. As was stated in last year's report,[1] the chairman, Dr. Lark-Horovitz, requested that he be relieved of his duties. The nominating committee presented the name of Dr. E. C. Stakman. No statement was ever received from the nominating committee concerning the action of Dr. Stakman. However, it can be assumed that he refused the appointment, since the nominating committee later submitted the name of Dr. Morris Meister. Dr. Meister accepted the nomination. He was elected unanimously by the members of the Committee at the meeting in Washington, D. C., on November 17. The resignation of Dr. Lark-Horovitz on November 1 then became effective in fact.

The representative of the Mathematical Association of America, Dr. Raleigh Schorling, died during the year.

The following persons either resigned from the Committee or were replaced with other representatives:

1. Dr. Ralph C. Huffer representing the American Astronomical Society.
2. Dr. Karl Lark-Horovitz representing the American Institute of Physics and American Association of Physics Teachers.
3. Dr. Glen W. Warner representing the American Association of Physics Teachers.
4. Mr. Arthur O. Baker representing the Central Association of Science and Mathematics Teachers.
5. Dr. E. C. Stakman representing the Executive Committee of the AAAS.
6. Dr. J. R. Mayor, representing the National Council of Teachers of Mathematics. (Dr. Mayor, however, now represents another organization on the Committee.)
7. Dr. B. L. Dodds representing Section Q (Education) of the AAAS.

Professor Ralph Lefler has also requested that his resignation as secretary of the Committee become effective as soon as another secretary can be obtained. At the present time, a new secretary has not been appointed.

It can be seen, therefore, that the Committee will be working this coming year with a new chairman, a new secretary, and a change of about one-half of its representatives. The program of the committee, however, is sufficiently planned, so that no major slowdown is anticipated.

The present membership and representation are as follows:

1. Chairman and representative of the National Science Teachers Association
   Dr. Morris Meister, Principal
   Bronx High School of Science
2. American Association of Physics Teachers and The U. S. Office of Education
   Dr. Bernard B. Watson
   Division of Higher Education
   U. S. Office of Education
3. American Astronomical Society
   None
4. American Chemical Society
   Dr. C. H. Sorum

* A report presented at the annual meeting of the National Association for Research in Science Teaching in Atlantic City, February 19, 1951.

[1] George Greisen Mallinson, "A Report to the NARST on the Activities for 1949–50 of the Cooperative Committee on the Teaching of Science and Mathematics of the AAAS." *Science Education*, XXXIV (April 1950), 177–80.

Department of Chemistry
University of Wisconsin

5. American Institute of Physics
Dr. J. W. Buchta
Department of Physics
University of Minnesota

6. American Nature Study Society
Dr. Glidden S. Baldwin
Danville, Illinois

7. American Society of Zoologists
Dr. L. V. Domm
Hull Anatomical Laboratory
University of Chicago

8. Botanical Society of America
Dr. Glenn W. Blaydes
Department of Botany
Ohio State University

9. Central Association of Science and Mathematics Teachers
Mr. Donald W. Lentz, Principal
Ridge Road School
Parma, Ohio

10. Division of Chemical Education of the American Chemical Society
Dr. Laurence L. Quill
Department of Chemistry
Michigan State College

11. Executive Committee of the American Association for the Advancement of Society.
Dr. W. S. Hunter
Brown University

12. Geological Society of America
None

13. Mathematical Association of America
Dr. J. R. Mayor
Department of Mathematics
University of Wisconsin

14. National Association of Biology Teachers
Mr. Prevo L. Whitaker
University School
University of Indiana

15. National Association for Research in Science Teaching
Dr. George G. Mallinson
Departments of Psychology and Education
Western Michigan College of Education

16. National Council of Teachers of Mathematics
Mr. George E. Hawkins
Lyons Township High School and Junior College
La Grange, Illinois

17. Section Q (Education) of the American Association for the Advancement of Science
Dr. Francis D. Curtis
School of Education
University of Michigan

FUTURE MEETINGS

Over the last few years it has been the general policy for the Cooperative Committee to meet in the fall at Chicago, and again in the spring, usually at Chicago. Another meeting was held sometimes at the Christmas Convention of the AAAS.

This last year, however, the Committee met only once. This meeting was held on November 17 and 18, 1950, in Washington, D. C., in conjunction with the Interdivisional Science Committee of the U. S. Office of Education. The usual spring meeting was not held in 1950, because of (1) previous commitments on the part of the chairman, and (2) lack of immediate business. This is in no sense a criticism of the chairman since he had proffered his resignation some time before for that very reason.

The usual Christmas meeting was not held in 1950 at the Cleveland Convention of the AAAS, as a result of a decision made by the members. It was believed that the time of members was well occupied by other meetings. Hence, it was almost impossible for all members to be present, or to devote sufficient time for discussing thoroughly the business of the Committee.

At the November meeting it was decided that future meetings would be scheduled as follows:

1. Every fall, a joint meeting with the Interdivisional Science Committee of the U. S. Office of Education, to be held in Washington, D. C.

2. Every spring, a meeting of the Committee for furthering its own program, to be held probably in Chicago.

3. A meeting at the annual convention of the AAAS would be held only at the wishes of the members, and if the exigencies of business matters demanded it.

POLICIES AND PROGRAMS

The general plans for the meetings of the Cooperative Committee have been under scrutiny for some time. It was believed by a number of the members, that if the agenda were restricted to fewer items, and the meetings devoted to one or two of them, more could be accomplished.

Although no direct statement was made, the following plan seemed to be more or less tacitly approved.

1. The fall meeting with the U. S. Office of Education would be devoted to discussion of a number of problems of mutual interest to all groups participating.

2. The spring meeting would be devoted to an intensive study of one of the problems raised at the fall meeting, or one considered by the members to be pressing. It was apparently decided that any other organizations that might be interested in the problem under consideration would be invited to send representatives to the meeting of the Committee. Later, the action of implementing the program that emerged might be a cooperative enterprise of all participating societies rather than one of the Committee alone.

This procedure may be adopted for the coming meeting in the spring of 1951. It was suggested that the theme for this meeting might be *The Improvement in Training and Certification of Teachers of Science.* Under the plan it was suggested that representatives of various agencies interested in teacher certification (i.e., American Council on Education, American Association of School Administrators, Association of Chief State School Officers) be invited. Whether or not the plan will materialize is still a matter of conjecture. However, the representation from any outside group at any meeting of the Cooperative Committee is to be kept on an invitational basis and will be determined by the agenda of each particular meeting.

The original statement of policies for the implementation of the program of the Cooperative Committee was questioned on three points by your representative. The statement was modified to satisfy certain considerations brought up in the questions.

First, your representative disagreed that all experiences for teaching methods for laboratory demonstration were the sole responsibility of the subject-matter departments. The statement was changed to place the responsibility in both the subject-matter and education departments.

Second, your representative questioned the desirability of having "young industrial scientists" assist teachers in teaching science. It was suggested that many young scientists have no conception of the operation of a school or its curriculum. The statement was amended to read "young industrial scientists with appropriate interests and backgrounds, may find an outlet for their energies and their interests in teaching activities by counseling with the high school science teacher relative to instruction practices and equipment."

Your representative is still not in agreement with this statement. It seems to connote that energies and interests of a young industrial scientist in teaching are sufficient to enable him to counsel science teachers. Your representative does not believe there is any evidence to substantiate such a view.

A third point of disagreement on the part of your representative is the continued reference to the "double-track" system for teaching mathematics and science. As yet there has been no direct expression of views by all members of the Committee with respect to the desirability of such a system. Yet, many assume it to be an established policy of the Committee.

Your representative believes that the major weakness in science teaching in the public schools is the lack of provision for a basic program in science and mathematics for the non-college entrance students. Most schools are too small to run two programs. Therefore, the emphasis should be placed on a general program for all students, rather than college entrance preparation for a few. Further, there is no evidence to indicate that the so-called college entrance sciences prepare students better for college than the general education courses in science. Hence, your representative will continue to support that view unless otherwise instructed by the NARST.

ACTIVITIES OF THE COOPERATIVE COMMITTEE FOR 1950–51

The activities of the Cooperative Committee for 1950–51 were centered largely

about the first annual meeting in conjunction with the U. S. Office of Education. Four groups participated in the meeting. They were (1) The Interdivisional Science Committee of the U. S. Office of Education, (2) The Cooperative Committee, (3) The Advisory Committee to the U. S. Office of Education on Science Education Research (Chairman, Dr. Francis D. Curtis), and (4) a group of classroom science teachers and supervisors at all levels (Chairman, Mr. Robert Carleton).

The general pattern of the conference was the meeting of the latter three groups to discuss problems pertinent to their group in the teaching of science. Then on two occasions all groups met together and presented summaries of their deliberations. The reports of the separate groups are included *in toto* in the brochure.

In essence, the following were the major items of discussion by the Cooperative Committee.

1. Dr. Bernard Watson discussed the joint project between the McGraw-Hill Book Company and the American Association of Physics Teachers in the production of several physics films to be released in 1951. A report of the study was submitted by Watson with the thought that it might serve as a pattern for the individual societies in the Cooperative Committee. The Committee then passed the motion "that the AAAC Cooperative Committee endorse the plan used by the AAPT as reported by Dr. Watson of our Visual Aids Sub-committee and that we recommend that the organizations represented on the Cooperative Committee explore the extension of the idea."

A major discussion was held also on reestablishing the sub-committee on teacher education. Included in the brochure is the No. 4 report of the Committee, "The Preparation of High School Science and Mathematics Teachers," and also included is a preliminary report of a later committee. These reports were referred to in connection with the possible theme of the spring meeting.

On the second day, the question was raised "as to whether the Committee could best serve as a catalyst in encouraging projects or as an action group.

It was decided that the Committee could serve in both respects, that is, (1) it could collect and disseminate information and good ideas for action by other groups, (2) it could act in an advisory capacity to groups studying problems of interest to the Committee, (3) it could be an operating committee in areas where it has competence and resources."

A statement of the problems of interest to the Cooperative Committee was then made. The problems are these:

1. Teacher certification including the fifth year program. Differentiation of the fifth year program from the Masters' degree program.

2. Provision of adequate practice teaching experience. Utilization of subject-matter specialists in the supervision of practice teachers. Greater recognition for the services of the classroom teacher immediately responsible for supervising the student teacher.

3. The in-service training program. Aiding teachers to keep abreast of advances in subject matter and teaching techniques.

4. Provision of an adequate science offering for all students; general education and college bound. The double track approach.

5. Adult education in science—scientific literacy.

6. Appropriate laboratory and demonstration equipment. The implication of good laboratory teaching on the teaching load.

7. Activities of College Entrance Boards. The objective evaluation af essay type tests.

8. Impact of Universal Military Training on curriculum and supply of teachers.

9. The place of science in the core curriculum.

10. Evaluation of the effect of understanding science on behavior. Construction of tests for understanding and tests for behavior evaluation.

11. Identification and recruitment of the science talented. Extending the opportunities for study of the science talented.
12. Improvement of college instruction.
13. Conservation education.
14. Preparation of guidance material in the science.

Finally in order to publicize the work of the Committee, it was decided that "Each member of the Committee will prepare a statement relative to the work of the Committee for publication in the Journal of his Association. This will be done following each meeting. Reprints of these notes will be provided the secretary for the permanent file of the Committee."

Summary

In summary, your representative believes firmly that the Cooperative Committee has tremendous potentialities for influencing the teaching of science. Much has been done previously by the Committee in both program and action. At present it seems that the Committee is spending much time on program and policy, with less emphasis on action. This is realized by a number of the members of the Committee.

It would seem desirable to reevaluate the success of the various actions of the Cooperative Committee. Then those procedures for action that have proven successful should be applied to a few of the most pertinent problems in the teaching of science. It is doubtful whether there is sufficient time and energy available from all the members of the Committee to accomplish everything that confronts it. However, the present plan for the spring meeting seems to be in accord with this suggestion.

INFORMATION CONCERNING SCIENCE EDUCATION RESEARCH 1949 AND 1950 *

A Report to the National Association for Research in Science Teaching

Philip G. Johnson

Secretary to the Office of Education Advisory Committee on Science Education Research

One year ago we were considering plans for gathering and disseminating information concerning science education research. Our plans had been thoughtfully developed and we hoped that something would come from the plans. In short, one year ago we had plans and hopes. What do we have now, one year later? We have some accomplishments. We still have plans, hopes, and in addition we have some new problems. A report on activities and accomplishments may help us to see how we may improve our plans, increase our accomplishments, and reduce our problems.

Shortly after our meeting a year ago our plans for gathering and disseminating information concerning science education research were formally presented to the Research and Statistical Service of the Office of Education. This presentation included a description of the plan, a justification for the project, a copy of the proposed form, and a copy of the proposed covering letter. After the usual interval there was an invitation to confer about these materials. Some suggestions for changes were made and following a revision and review of the changes, the plan with the form and covering letter were delivered to the Bureau of Budget for clearance. Weeks passed before there was an opportunity to discuss the plan and to receive even general suggestions for necessary changes. This was due to the fact that a number of other federal agencies were interested in this project and each of these was consulted.

* Reported at the annual meeting of the National Association for Research in Science Teaching in Atlantic City, February 19, 1951.

Again time marched on before reactions to the plan were available. In the course of the discussion certain changes were made in the materials and many of the changes were improvements. However, some of the required changes have caused confusion among those who were interested in making the project successful. The first principal change made the project an annual collection of information and the second change added the gathering of information concerning research studies in "applied science and technical training." The necessary changes were incorporated and requests for duplication of materials were made. The Korean incident came upon the scene and materials were not ready until July. Even though it was known that many respondents would be away during the summer it was decided to launch the project and use a fall follow-up request to improve the coverage. The forms were mailed on July 27th and within a few weeks reports were beginning to come in.

We were faced in the fall with the problem of either issuing a very incomplete list of studies or endeavoring to secure more complete returns. We decided to make tentative plans for a follow-up request and to ask the Advisory Committee at its meeting on November 17–18 to review progress on the project and to recommend what we should do about the preparation of a listing. It was their suggestion that a follow-up should be sent and the preparation of a listing should be delayed. The summaries which are here presented are based on returns which had come in by the middle of January, 1951, when a listing of studies was sent to each chairman of the various NARST level committees. Let us now look at the general accomplishments.

It is interesting to note the extent to which science education leaders responded to the invitation that they report studies.

TABLE 1

THE NUMBER OF STUDIES REPORTED

	Number
Studies completed before July 1, 1948..	8
Studies completed between July 1, 1948, and June 30, 1949.....	9
Studies completed between July 1, 1949, and Dec. 31, 1949.....	35
Studies completed between Jan. 1, and June 30, 1950	41
Studies completed after July 1, 1950....	14
Total Studies Reported.....	107

TABLE 2

EXTENT OF RESPONSES

	Number	Per Cent
Persons contacted in first mailing and follow-up	214	100
Reported studies	31	14.5
Reported no studies completed in the designated period.....	105	49.0
Failed to respond.....	72	33.7
Changed work or deceased....	6	2.8
New names suggested for leaders list	80	

Let us look at the studies in a general manner to see what kinds of investigations were reported. This summary will be limited except where otherwise specified to 95 studies on which adequate information was available.

TABLE 3

DEGREES RELATED TO THE STUDIES

	Number
No degree (non-thesis) studies.....	18
Master of Science, Arts, Education, etc.	45
Doctor of Education.....	19
Doctor of Philosophy	13
Total.....	95

TABLE 4

MONTH WHEN STUDIES WERE COMPLETED (93 STUDIES)

January	3	May	12	September	11
February	3	June	22	October	3
March	2	July	13	November	1
April	6	August	15	December	2

TABLE 5

AREAS OF SCIENCE INVOLVED IN STUDIES

	Number
All Sciences	18
Biological Science	30
General Science	21
Chemistry	22
Physics	10
Physical Science	9
Earth Science	12
Other	19

TABLE 6

GRADE LEVELS CONCERNED IN STUDIES

	Number
K–3	8
4–6	11
7–9	30
10–12	51
Junior College	15
Higher	24
Other	2

TABLE 7

SOURCE OF DATA USED

	Number
Books, Periodicals	46
Textbooks	28
Courses of Study	17
Experimental Groups	23
Central Groups	13
Interviews	21
Expert Judgments	18
Questionnaires	32
Other	22

TABLE 8

PHASES OF SCIENCE EDUCATION INVESTIGATED

	Number
Audio-Visual Aids	13
Classroom-Instruction	38
Laboratory Instruction	30
Camp and Field Instruction	12
Club	5
Curriculum	30
Equipment and Supplies	12
Evaluation	20
Objectives and Philosophy	18
Rooms and Furnishings	5
Supplementary Reading	8
Teacher Education	18
Text and Workbooks	20
Other	8

TABLE 9

STATISTICAL TREATMENT USED

	Number
None	51
Mean	18
Median	12
Standard Deviations	13
Coefficient of Correlation	8
Critical Ratio	6
Fishers "t"	2
Chi Square	3
Comparison of Frequencies	20
Variance and Co-Variance	4
Other	6

TABLE 10

WHERE STUDIES ARE AVAILABLE

	Number
University Library	58
Department Library	23
Author	22
Sponsor	4
Other (including not available)	5
Office of Education	2

The persons serving the Office of Education in an advisory capacity relating to science education research spent two days (at their own expense) in the Office on November 17–18. Problems relating to this project were presented to them. They were particularly challenged by the idea of developing a set of proposals concerning the needed research which should be undertaken. Their report follows.

AREAS OF RESEARCH SUGGESTED AS BEING OF IMMEDIATE AND GREAT IMPORTANCE IN THE FIELD OF THE TEACHING OF SCIENCE

By the U. S. Office of Education Advisory Committee on Science Education Research:

Charlotte L. Grant
Guybert P. Cahoon
Francis D. Curtis, *Chairman*
Elizabeth Lockwood, President of N.A.R.S.T. and Ex-officio committee member

I. Studies to determine the conditions that actually exist with respect to the teaching of science.

*1. An investigation to determine what aspects of science courses now being taught are potentially useful in the present world situation.

2. An investigation of the actual training and experience possessed by teachers of elementary and secondary-school science, for the courses that they are teaching.

3. An investigation of the existing classroom, laboratory and other practices, conditions and facilities with respect to teaching the various branches of science in typical situ-

* The starred studies are deemed the ones of greatest immediate importance.

ations. Special emphasis should be placed upon the investigation of demonstration and laboratory work in small high schools possessing limited resources.

4. A study of the tenure of science teachers.
5. A determination of the existing facilities and practices for science education at the elementary and secondary levels, for youths and adults who are not attending regular elementary and secondary schools.
6. A study of the types of remunerative employment in which science teachers engage as a means of supplementing their incomes from teaching.

II. Studies to improve the teaching of science in its various aspects.

*1. An investigation to determine what supplementation and extension of the existing science program for secondary schools is demanded by the present world situation.
*2. An investigation to determine what materials should be included in a series of source materials for specific areas such as aviation, conservation, and atomic energy.
*3. A determination of appropriate means of extending and improving the facilities for science education at the elementary and secondary levels, planned for youths and adults who are not attending regular elementary and secondary schools.
4. A determination of the optimal means of discovering boys and girls possessing marked scientific interests and potentialities.
5. An investigation of out-of-school facilities to determine their potentialities for implementing science courses.
6. A determination of effective and practicable means and materials that will improve the subject-matter background and professional competence of teachers of science in the elementary schools, and an investigation to discover the institutions that provide aspects of such training.
7. A determination of the materials that should constitute a course of general physical science for secondary schools, that will be similar in function and complementary to the present course of general biology.
8. A determination of experiments that require only simple, readily-available and easily improvised equipment that are suitable for laboratory and demonstration work in the various science courses.
9. A determination of an adequate selection of laboratory experiments for the various courses of secondary-school science, that can be performed by individual pupils in thirty to forty minutes.

The Committee suggests that the investigations of status (Group I) can most effectively be carried out by the Office of Education of the Federal Security Agency. Certain studies in Group II can be carried out only, or at best, after the related studies in Group I have been completed.

Succeeding steps in the research program here suggested include surveys and analyses of programs already activated, determination of suitable materials in the findings of investigations already available, and decisions regarding further studies to be made together with plans for their implementation. These further steps can appropriately be taken by a "Steering Committee" composed of the Advisory Committee, the Science Specialists of the Office of Education and representatives of the Cooperative Committee, the N.A.R.S.T., and the N.S.T.A.

Let us now look at some of the problems which we should face and attempt to solve so that this project may grow in overall coverage and usefulness. From the point of view of the secretary for this project these problems are as follows:

1. How can we best stimulate the types and the quality of science education research which needs to be done?

2. How can we approach the securing of information on 100 per cent of the science education research which is completed within specified periods?

3. Which studies of those reported to the Office of Education are worthy of reporting to persons interested in science education research?

4. What should be the format and general content of the reports which are prepared to summarize the science education research activities for any period? How can the work be done and how can the summaries be made available?

5. To what persons should summaries of science education research be sent and what should they be encouraged to do with the summaries?

6. What revisions should be made in the report form and when should invitations to report studies be sent out?

7. Should some type of simple postal card be enclosed with the request for reports so that we may know what reports to expect and what needs for additional forms may exist among potential respondents?

8. What changes in general operating policies and practices should be made to improve this project?

Many of you have participated in this project. Your efforts are appreciated. Many others, perhaps some of you, should have participated, your interest and help is desired. All of us have a responsibility in the development of our profession. Let us work together with devotion to the idea that science shall become a significant aspect of education at all levels and for all ages.

PROGRESS REPORT OF THE COMMITTEE ON EDUCATIONAL TRENDS [1] *

THE Committee on Educational Trends has conceived its initial function to be the identification of emphases and concerns currently to be found in educational policy and practice. Such emphases, of course, differ in kind: some, for example, are methodological; others philosophical; others organizational. Similarly, the emphases differ in tone: some have a note of urgency; others call for long-range planning. Necessarily, the emphases also differ in significance for science teachers, and in validity as reckoned on philosophical bases.

The Starting Point—Definition

So, to provide some common ground for discussion, albeit an arbitrary one, "educational trends" was defined operationally by citing the following examples: emphasis on life-adjustment curricula; organization of instruction in terms of community problems; increased pupil responsibility for planning learning experiences; stress on understanding of ways in which children learn; concern with methods of thinking.

Admittedly, it would be a hopeless task to identify *all* current educational trends—hopeless and probably useless, for some would peter out and new currents would develop before anything could be done about those identified. And something

[1] The following members of the Committee participated in the preparation of this report: W. W. E. Blanchet, Ira Davis, Charlotte L. Grant, Charles W. Hoffman, Clark Hubler, Philip Johnson, Betty Lockwood, Elsa M. Meder, Charlotte V. Meeting, Ellsworth S. Obourn, Zachariah Subarsky, W. C. Van Deventer. The Committee was assisted in its deliberations by the following members of the Association: Alfred D. Beck, Thomas Fraser, Morris Meister, Vaden W. Miles, and Nathan Washton.

* First Annual Progress Report of the Committee on Educational Trends, National Association for Research in Science Teaching, by Elsa Marie Meder, *Chairman*. Report presented at the meeting of the Association in Atlantic City, February 19, 1951.

should be done about them; identification for the sake of identification is nothing but busy work.

To get started, eleven members of the Committee, working as individuals, prepared statements concerning trends in educational practice or philosophy which seemed of special importance to them. When these statements were examined by the Committee working as a group, it was found that the trends identified fell into three major but non-discrete classifications: (1) trends toward more science in the schools, (2) modifications in methods, and (3) emphases in the philosophy of science education affecting practice. It should be noted that, in the statements that follow under these three headings, the Committee is not attempting to say whether the trends are good or bad, nor to express its judgment as to whether they should be encouraged or discouraged. Such value judgments are important, but would be premature at present.

Toward More Science in the Schools

Tendencies to include more science courses in the curriculum were recognized at three levels of instruction: elementary, secondary, and general college.

At the elementary level, it appears that more physical facilities for experimental work are being provided; that curriculum work on science is gaining impetus; and that the use of helping teachers and consultants for science is increasing. It was stated also that, since elementary-science programs are often geared to the environment rather than the text or courses of study, they will be modified quite easily to conform to changing conditions. In this connection one person predicted that "the development of elementary science will be accelerated by the changing times, mostly through the influence on teachers and other adults."

At the high-school level, various members of the Committee found a tendency toward the development of continuous and sequential programs, and others recognized an accompanying tendency to differentiate between the "general" group of students and the reservoir of future research scientists. In regard to the latter, one person made this statement:

"It appears to me our most urgent problem in science education is knowing what to do with the upper 50 to 60 per cent of our students. What kind of 'stepped-up' program do we need to give these students a type of study or curriculum that will really challenge their abilities?

"Most people are always talking about the lower 50 per cent, and especially the lower 25 per cent. They learn very little no matter what we teach. It is the upper 50 per cent that really learn but we have been holding them back because we think in terms of the lowest group."

At the general-college level, three trends were identified, as follows: (1) emphasis on what President Conant calls "the tactics and strategy of science" for general education, rather than facts for facts' sake; (2) formalization of science for general education in terms of "our cultural background" or "an understanding of the basis for western civilization" or some such thing; (3) attention to what might be called "social consciousness for science and scientists," exemplified by reaction of scientists toward such issues as the manufacture and use of the atomic bomb, and the interrelationship of science and religion or science and philosophy.

Modifications in Methods

Most of the trends in methodology were concerned with methods of organizing content, although the Committee feels that there are modifications in methods of administering and supervising science instruction which should be identified and examined.

Five trends in methods of organizing content were recognized. First was the development of the core-curriculum type of course integration. Concerning this development, this documenting statement was made:

"The emphasis here is on training future teachers to realize and utilize the dependence of one course upon another. This is being tried out

in the elementary and secondary education groups, particularly in the suburban schools where the students are sent for their Observation and Practice Teaching."

Closely related is an increased emphasis on functional understanding of scientific methods and attitudes. This emphasis results in stress on the problem approach, increased use of local and community resources, the development of meaningful projects, and work conferences for teachers. The third trend is an extension of this increased emphasis on functional understandings: the recognition of real experiences, including work experiences, as a part of high school instruction. The fourth trend is also an extension of increased emphasis on functional understanding—the trend toward using individual and small group procedures, toward less miniature lecturing and more committee, team, and individual work.

Of a different order is the trend toward using new media of communication, especially television. One of the most popular programs in the Philadelphia area, for example, is said to be the televised "Science Is Fun" program, put on by the Franklin Institute.

Trends in Educational Philosophy Affecting Practice

How to place stress on methods of thinking has long been a pervasive concern of many science educators; and this concern is one of the two trends in the philosophy of science education which were mentioned by Committee members. One person pointed out that the tactics and strategy of science concept represents a valuable and fruitful trend toward the kind of science that meets layman's needs in a complex modern civilization. Another spoke of a growing concern with application of methods of deductive thinking in all fields, especially social, economic, and political.

The second trend classified under philosophy of science education affecting practice is the current stress on life adjustment. One person felt that "building curricula around student and societal needs" had these potential results:

Greater student and community interest
Greater participation by community leaders in school activities
Greater contribution of students to betterment of community
Fewer drop-outs in high school
Less maladjustment among high school youngsters
Better integration among departments and subject-matter areas
Better use of community and school resources

Several persons pointed out that present national and international conditions have implications for education that purport to be a process of life adjustment. Obvious implications, of course, are modifications in subject matter. An emphasis on civil defense, on self-sufficiency and ability to help in times of calamity, brings with it stress on first aid and home care of sick; on understanding of potential hazards and how to avoid or endure them; on information about nutrition and the maintenance of health. The imminence of military service for many leads to concern with giving information about aviation, meteorology and the like, and with developing understanding of opportunities and responsibilities in military service and related work. The economic situation calls for citizenship education and implies studies in the physical sciences (for example, about transformation of materials) and in the area of conservation.

Perhaps less obvious, but in the opinion of at least one Committee member far more important, is the implication which he stated in the following words:

"Underlying the hot war is the cold, ideological war, and underlying the cold war are historical forces. The development of science and the industrial revolution which science engendered helped European man free himself from political despotism. A *new* despotism now rides the industrial and technological revolution and threatens to engulf us. It behooves us as science teachers to stress the historical, humanistic, liberalizing aspects of science, even if we do so at the expense of teaching technology. We must seize every opportunity in all our science courses to emphasize the fact that the development of science as a

pattern of thinking was a struggle against historic prejudices. We must, above all, cite actual examples where science today, under totalitarianism is languishing or dying. We must even in our generation continue the struggle to keep science free.

"To summarize, the trend which I hope will emerge out of our present adversity is the trend in science teaching which emphasizes science as a great liberalizing movement, and as one of the strongest forces for international-mindedness, a necessary prerequisite to world peace."

The Next Steps

The Committee recognizes that, in its brief life, it has failed to identify certain important trends. It has mentioned only those which have come to the attention of its members most strongly; had the personnel of the Committee been different, other trends would doubtless have been identified (for example, the growing recognition of the importance of emotional learning). Consequently, the Committee hopes that those who read this report will help supplement it. What important educational trends have been missed?

Thus far, the activities of the Committee have largely been "arm-chair exercises." They were a necessary preliminary, but clearly they were only a preliminary. What is needed is a collection of descriptions of the identified trends (and others) in action. To what extent are these trends exhibited? How are they manifested? What do they mean for the future? The Committee would greatly appreciate the assistance of workers in science education throughout the country, and would welcome their comments and criticisms.

Then, there is the whole matter of value judgment. How desirable are certain trends? How important are they? There seems to be no point in being like the man who got on his horse and rode off in all directions. But in what direction shall we go? There are some who seem to feel that tomorrow is Armageddon: do it now, or there will never be a chance to do it. There are others who, while granting that long-range hopes and plans and efforts are in vain if Armageddon is tomorrow, feel nevertheless that human goods can be attained only by aiming at what Bradford Torrey called "the goal that is not gained by speed."

"These ought ye to have done, and not to leave the other undone."

PROGRESS REPORT OF THE COMMITTEE ON RESEARCH IN PROBLEM-SOLVING IN SCIENCE TEACHING *

THE Committee on Research in Problem-Solving in Science Teaching of the National Association for Research in Science Teaching is attempting to bring together bibliographical references to all studies that have dealt directly with problem-solving in science teaching. During the past year a careful search has been made of standard library guides and bibliographies to locate all such studies. It is believed that most, if not all, of the published studies are listed in a preliminary bibliography which members of the committee are checking for omissions. It is hoped that the bibliography may be ready for distribution within the next year.

* Fourth Annual Progress Report of the Committee on Research in Problem-Solving in Science Teaching, National Association for Research in Science Teaching, by J. Darrell Barnard, *Chairman*. Report presented at the meeting of the Association in Atlantic City, February 19, 1951. This is the First Annual Report of the Committee as here named; however, the designation Fourth is used at the request of the chairman of the Publications Committee because the work on problem-solving has been reported for each of the last three years by the Committee on Research in Secondary-School Science.

PROGRESS REPORT OF THE COMMITTEE ON RESEARCH IN ELEMENTARY SCIENCE †

THE Elementary Committee of NARST met during the morning and afternoon of February 18, 1951. Those in attendance in one or both of the discussions were: Doctors Adragna, Barnes, Bingham, Elzey, Hubler, McCollum, Metzner, Pruitt, Raskin, Reynolds, Riedel, and Wyatt.

Discussion centered around two themes: (1) The evaluation of current researches in Elementary Science and the publication of short abstracts of the ones which the committee felt should be publicized. (2) The planning of research which the committee may undertake cooperatively.

The committee agreed to focus its attention upon current researches reported to the U. S. Office of Education—that it would not attempt to review outstanding contributions of the past. After some discussion it was decided to limit the reviewing to those studies that are clearly research; that it is not the function of this committee to review developmental projects no matter how useful they may be.

To deal with the researches reported for the period, July, 1949–June, 1950, various members of the committee agreed to procure and to prepare abstracts of one or more of them. Such abstracts are to be sent directly to Doctor F. A. Riedel who volunteered to edit them for publication in *Science Education*.

To deal with researches reported during the current year, July, 1950–June, 1951, the following steps were planned:

1. The U. S. Office of Education will send to the chairman of each level committee a copy listing all researches reported in science education.

2. The Elementary Committee Chairman will select from this list, those titles related to elementary science and request from the U. S. Office of Education the Research Study Report for each.

3. The Elementary Committee Chairman will then assign these various research studies to the individual committee members who are in the best position to procure or to prepare abstracts of them.

4. Such committee members will prepare or procure abstracts of the assigned research together with permission to publish such abstract *; send one copy of the abstract to the Elementary Committee chairman and, if possible, bring one copy to the annual meeting of NARST. Each resumé should be limited to 500 words or less and should include:

   a. Title
   b. Author
   c. Institution in which the study was made
   d. Date of completion of study
   e. Statement of the problem
   f. A description of the methods and techniques employed
   g. A list of the significant findings and conclusions

5. If the committee member finds the research worthy of additional consideration he is expected to invite the author either to come to the NARST meeting and discuss his findings with the Elementary Committee or to prepare and send a more extensive resumé to be presented to the Committee. In this connection, Elementary Committee members are expected to be on the alert to discover candidates who should be recommended for membership in NARST, and to recommend such candidates for membership.

† Fourth Annual Progress Report of the Committee on Research in Elementary Science, National Association for Research in Science Teaching, by N. E. Bingham, *Chairman*. Report presented at the meeting of the Association in Atlantic City, February 19, 1951.

* A special form for procuring such permission has been prepared by the coordinating committee; copies of this form will be sent to committee members together with review assignments.

6. At the Annual Meeting, the first session of the Elementary Committee will be concerned with a discussion of resumés of Elementary Science Researches, their publication, and possible presentation in the general session.

Not only is the Elementary Committee concerned with reviewing and publicizing worthy research; it is also concerned with promoting further research in Elementary Science Education. It seemed that the best way to achieve this end is to have the committee carry on such research cooperatively—that the second session of the Elementary Committee at the next annual meeting should consist of progress reports on such research. It was agreed that the members of the Elementary Science Committee should study "On the College Level, What Experiences Do Pre-Service Students Have That Enable Them To Teach Elementary Science Effectively?"

The means of carrying on the study include:

a. A report by participating committee members on a particular program with which they are familiar, together with an evaluation of this program.
b. An evaluation of the program by students who have participated in it.
c. An evaluation of the program by in-service people from 1–3 years after they have participated in it.
d. An over-all summary and evaluation by the Elementary Committee.

Dr. Clark Hubler agreed to prepare a tentative draft or outline to be used by each member of the committee. This outline is now in the hands of the members of the committee.

PROGRESS REPORT OF THE COMMITTEE ON RESEARCH IN COLLEGE SCIENCE *

THIS committee made its final report at the 1950 meeting on its original assignment of surveying the types and trends in general education science courses at the college level. At this time it was reorganized along with the general reorganization of committees, and increased in membership. It was given the general charge of continued cooperation with the program of reviewing research literature and promotion of research.

Following the 1950 meeting the membership of the committee was polled to determine the specific interest areas within the general assignment in which the members wished to work. The following areas were defined:

1. Review of current published and unpublished literature in the field of science in general education at the college level.
2. Study of problem in evaluating attitudinal and other non-factual objectives in general education college science courses.
3. Study of curriculum and subject-matter problems.

At the 1951 meeting of N.A.R.S.T. the following committee members were present: Vaden W. Miles, Nathan S. Washton, Waldo W. E. Blanchet, H. B. Crouch, Thomas P. Fraser, Charles W. Reynolds, and W. C. Van Deventer. Other members of the committee who helped carry on the work of the committee during the year by correspondence were Edward K. Weaver, Robert A. Bullington, Oliver S. Loud, Clyde M. Brown, Thomas P. Dooley, John H. Woodburn, and E. Z. Friedenberg.

During the year a group within the committee who were particularly concerned with evaluation problems carried on correspondence for the purpose of exchange

* Fourth Annual Progress Report of the Committee on Research in College Science, National Association for Research in Teaching, by W. C. Van Deventer, *Chairman*. Report presented at the meeting of the Association in Atlantic City, February 19, 1951.

of ideas and materials. Also two members of the group, Loud and Van Deventer, participated in the Cooperative Study for Evaluation in General Education of the American Council of Education. This evaluation group reported its activities at the 1951 meeting but did not feel that it had progressed sufficiently to justify drawing conclusions or presenting tangible results.

Vaden Miles reported his work in reviewing published literature in the field of general education college science. This is a continuing project carried on by Dr. Miles for the committee. He discussed plans for publishing his accumulated material and getting it into the hands of those who might effectively use it.

Nathan Washton reported the second section of his study of basic biological principles and their use in teaching. The first section was reported at the 1950 meeting. A preliminary report of Clyde Brown's study of the use for teaching purposes of science material published in current popular periodicals was presented in his absence by another member of the committee.

Most of the committee's time was spent in working through the reports of unpublished science education research studies which had been collected by the U. S. Office of Education and made available to N.A.R.S.T. This was a part of the work carried on by all of the grade level committees in connection with the project embarked upon by N.A.R.S.T. last year. Criteria were set up for determining what types of studies to include and plans were made for securing abstracts of selected studies for publication in SCIENCE EDUCATION later this year. A long range program was also adopted for selecting titles, securing abstracts, distributing them to committee members and considering them at annual meetings as a preliminary to later publication. It is hoped that this plan will not only result in a careful and critical selection of abstracts and studies for publications in Science Education, but also that it will bring about the widest possible participation of committee members in committee activities, enrich the annual meetings, and promote acquaintance by committee members with researchers in their geographic areas.

MEMBERSHIP OF THE COMMITTEE ON RESEARCH IN COLLEGE SCIENCE

(With special interests indicated)

1. Dr. Charles W. Reynolds
   East Carolina Teachers College
   Greenville, North Carolina
   Evaluation subcommittee; literature review
2. Dr. Edward K. Weaver
   Bishop College
   Marshall, Texas
   Evaluation subcommittee
3. Dr. Robert A. Bullington
   Northern Illinois State Teachers College
   DeKalb, Illinois
   Evaluation subcommittee
4. Dr. Vaden W. Miles
   Wayne University
   Detroit, Michigan
   Evaluation subcommittee; publication committee; literature review
5. Dr. Oliver S. Loud
   Antioch College
   Yellow Springs, Ohio
   Evaluation subcommittee; A.C.E. project on objectives and evaluation in general education
6. Dr. Nathan S. Washton
   Queens College
   Flushing, New York
   Evaluation subcommittee; literature review; curriculum
7. Dr. Waldo W. E. Blanchet
   The Fort Valley State College
   Fort Valley, Georgia
   Evaluation; literature review
8. Dr. Clyde M. Brown
   Stephens College
   Columbia, Missouri
   Use of science-in-the-news for classroom teaching; curriculum
9. Dr. Hubert B. Crouch
   Tennessee A. and I. College
   Nashville 8, Tennessee
   Evaluation; literature review
10. Dr. Thomas P. Dooley
    Prairie View College
    Prairie View, Texas
    Literature review
11. Dr. Harley F. Glidden
    Colorado State College of Education
    Greeley, Colorado

12. Dr. H. H. Jensen
Northern State Teachers College
Aberdeen, South Dakota

13. Dr. Mervin E. Oakes
Queens College
Flushing, New York

14. Dr. John H. Woodburn
Illinois State Normal University
Normal, Illinois
Evaluation subcommittee; science-in-the news

15. Dr. E. F. Friedenberg
University of Chicago
Chicago 37, Illinois
Problems of curriculum, especially organization of general education science courses

16. Dr. Donald Boyer
Head, Science Department
Winnetka Public Schools
Winnetka, Illinois

17. Dr. W. C. Van Deventer, *Chairman*
Stephens College
Columbia, Missouri
Literature review; evaluation subcommittee; A.C.E. project on objectives and evaluation in general education; curriculum problems in general education science courses

18. Thomas P. Fraser
Morgan State College
Baltimore 12, Maryland
Literature review; evaluation subcommittee; curriculum

PROGRESS REPORT OF THE COMMITTEE ON RESEARCH IN SECONDARY-SCHOOL SCIENCE *

AT THE 1950 meeting of the NARST in Atlantic City, all existing committees were abolished and new ones created. One of the newly created committees was the *Secondary-School Committee.* The roster of the committee was completed late in the fall of 1950, and now consists of the following members:

Kenneth E. Anderson
University of Kansas
Lawrence, Kansas

Richard R. Armacost
Purdue University
W. Lafayette, Indiana

Clarence H. Boeck
University of Minnesota
Minneapolis, Minnesota

Adrian N. Gentry
International House
Berkeley, California

Lee M. Harrison
Louisiana State University
Baton Rouge, Louisiana

E. O. Heiss
State Teachers College
New Haven, Connecticut

J. H. Jensen
Northern State Teachers College
Aberdeen, South Dakota

Paul E. Kambly
University of Oregon
Eugene, Oregon

Clifford G. McCollum
Iowa State Teachers College
Cedar Falls, Iowa

W. E. Martin
United States Office of Education
Washington, D. C.

T. A. Nelson
112 South Stone
La Grange, Illinois

William Reiner
81 Ocean Parkway
Brooklyn, New York

F. A. Riedel
Oklahoma A. & M. College
Stillwater, Oklahoma

Herbert A. Smith
University of Nebraska
Lincoln, Nebraska

Alden H. Struble
4940 Hurst Terrace, N.W.
Washington 16, D. C.

C. L. Thiele
467 Hancock
Detroit 1, Michigan

Percy H. Warren
Madison College
Harrisburg, Virginia

George C. Wood
P. O. Box 836
St. Petersburg, Florida

Lee R. Yothers
33 Henly Avenue
Cranford, New Jersey

Only three members of the above com-

* Fourth Annual Progress Report of the Committee on Research in SecondarySchool Science, National Association for Research in Science Teaching, by Kenneth E. Anderson, *Chairman.* Report presented at the meeting of the Association in Atlantic City, February 19, 1951. This is the First Annual Report of the Committee as here constituted; however, the designation Fourth is used at the request of the chairman of the Publications Committee because prior annual reports have been published under the name of Committee on Research in Secondary-School Science.

mittee were in attendance at the Atlantic City meeting. However, this group suggested a practical plan for reviewing important research in science education. This plan was adopted by the association and is being implemented by a committee consisting of Dr. Francis D. Curtis as chairman, with the committee personnel consisting of the chairmen of the level committees.

Early in December of 1950, the chairman suggested that the members of the committee submit a statement of needed research in science education on the secondary-school level. Three members of the committee replied. Their statements are as follows:

From Dr. Herbert A. Smith:

In accordance with my promise some time ago, I am forwarding my ideas relative to an area in which some research is badly needed.

I have long believed that the area of sex education has not received the consideration from science teachers which it should receive. The ways in which people mismanage their sex lives are all too common and too well known to need further elaboration. It is a leading social problem of the day. I recognize that a program of sex education is clearly a whole school undertaking. However, I believe that a science department should bear a major responsibility. It appears to me that biology instruction particularly ought to be a fruitful field for the development of programs of sex education. After all, the basic facts of sex can surely not be presented in a better setting or with any more impersonal approach than that possible of achievement through biology.

As teachers, we cannot be content with only the imparting of sexual information; even more pertinent, is the type of attitude which is the concomitant of instruction. Specifically, I believe that research aimed at the solution of such problems as those listed below offer possibilities which it would be very worthwhile to explore.

1. What contribution to a school sex education program can the science department make?
2. What kinds of programs of sex education do parents want and what kind will they support?
3. In biology, can teaching the principles of sexual reproduction in lower living forms develop more wholesome attitudes toward sex?
4. Do wholesome attitudes toward sex phenomena develop better in mixed or segregated classes of boys and girls?
5. What are the specific objectives which are to be realized through a program of sex education?
6. At what grade levels are various sex topics most appropriately introduced?

I recognize that the above list is not exhaustive. I am submitting these ideas primarily for the purpose of getting your reaction as well as the reaction of others.

From Dr. Percy H. Warren:

In compliance with your request, I am listing below some of the problems and areas in science education in which I feel that research is needed.

1. What is the relative effectiveness of different patterns of organization for student teaching in science?
2. What place, if any, do "teaching of" courses have in the preparation of science teachers?
3. What is the best design for a high-school science laboratory?
4. What are effective evaluation instruments for testing the results of teaching scientific methods, and scientific attitudes?
5. What constitutes the best preparation for high-school general-science teachers?
6. What should the certificate requirements be for a high-school teacher of general science?
7. What are the relative advantages of teaching science by experience units and by organized content topics?
8. What application of known psychological principles is being made to science teaching?
9. What uses can be made of personal conferences, testing, and other guidance procedures in improving science teaching in high schools?

From Dr. George C. Wood:

Suggested Fields of Investigation:

a. The best methods of development of the use of the scientific method by pupils.
b. The best methods of evaluation of the results of the conscious use of the scientific method by pupils.

A stimulating program of papers was presented at the Secondary-School Science sectional meeting on Fabruary 19, 1951, in the Blue Room of the Chalfonte-Haddon Hall. The program consisted of the following papers:

1. "The Fourth Annual Report of the Committee on Research in Secondary-School Science," by Kenneth E. Anderson, *Chairman.*
2. "A Summary of Data Obtained from a Questionnaire Study of the New York State Regents Examinations in Science," by David J. Miller, Delton High School, Delton, Michigan.

3. "A Study of a Group of High School Chemistry Teachers—Their Training and the Subjects They Teach," by Will S. Deloach, Mississippi State College for Women, Columbus, Mississippi.
4. "The Ability to Recognize and Apply Scientific Principles to New Situations," by J. Harold Owens, State Teachers College, New Haven, Connecticut.
5. "Achievement of Twins in Science," by Kenneth E. Anderson, University of Kansas, Lawrence, Kansas.
6. "Reading Difficulties of Textbooks in High School Physics," by George G. Mallinson, Western Michigan College of Education, Kalamazoo, Michigan.

PROGRESS REPORT OF THE ATOMIC ENERGY COMMITTEE OF THE NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING *

THE Atomic Energy Committee of N.A.R.S.T. defined three areas of general concern to the Committee:

1. Facts about actual programs in atomic energy education now under way including teacher training and adult education.
2. Evaluation of different kinds of atomic energy education programs through subjective judgments of N.A.R.S.T. members where more exact measures have not been made.
3. Identification of areas relating to atomic energy education in which educational research is needed.

The Committee concluded that because of the size and scope of these areas, other science organizations be invited to work on certain aspects of these problems and that there be left for the Committee itself only those tasks which are peculiarly and clearly the functions of N.A.R.S.T.

RECOMMENDATIONS

1.a. *Dissemination of facts regarding current educational programs.*

The Atomic Energy Commission prepares and maintains on a current basis a list of reported educational programs in atomic energy being carried on in schools throughout the country, and it is therefore unnecessary for N.A.R.S.T. itself to undertake the collection of information of this kind. The problem instead is how best to insure the dissemination of this material among teachers on as wide a basis as possible. This type of function fits in better with the purposes of N.S.T.A. than with those of N.A.R.S.T. It is therefore recommended that N.A.R.S.T. approve the transmittal of a letter from the Chairman of the Atomic Energy Committee of N.A.R.S.T. to the President of N.S.T.A. advising him of the existence of this information collated by the Atomic Energy Commission and of its importance to science teachers generally. It is further suggested that N.S.T.A. take whatever steps it can to promote the distribution of this information, including publication in whole or in summary form, in its journals or others, or as a part of a Science Packet, or in other ways.

1.b. In connection with the fact-finding function Dr. John Richardson of the Ohio State University was appointed Chairman of a sub-committee charged with *determining the types of activities carried on in the pre-service and in-service education of teachers* in connection with atomic energy education. The committee recommends that Dr. Richardson feel free to invite the cooperation of all members of N.A.R.S.T.

* First Annual Progress Report of the Atomic Energy Committee, National Association for Research in Science Teaching, by Jerome Metzner and Abraham Raskin, *Co-Chairman*. Report presented at the meeting of the Association in Atlantic City, February 19, 1951.

Prof. Richardson has agreed to report not later than the end of the year.

3. Dr. Abraham Raskin of The University of Chicago was appointed chairman of a sub-committee charged with *determining the degree of effectiveness of atomic energy education programs on all school levels.* This sub-committee will obtain as much information as it can through direct communication with the sponsors of programs listed in the Atomic Energy Commission's summary referred to in recommendation 1a above. This sub-committee is expected to submit its report in the early fall of 1951.

3. Dr. Jerome Metzner of the New York City Board of Education was appointed chairman of a sub-committee charged with the following:

a. *To define the most urgent problems and to ascertain the needs of people engaged in atomic energy education programs on all levels.*

b. *To re-formulate these problems and needs in the form of research projects.*

c. *To suggest to science and other organizations and agencies means of publicizing and/or carrying on these research projects.*

As source material, this sub-committee will use letters of inquiry received from both students and teachers by the Atomic Energy Commission both at its headquarters in Washington and at several of its installations in the field. These letters constitute a rich source of material on the actual needs of individuals participating in atomic energy education programs on all school levels. This committee is expected to complete its study by June, 1951.

4. The three sub-committees described above will report periodically to the Chairman of N.A.R.S.T.'s Atomic Energy Committee.

5. It is further recommended that the findings and recommendations of the three sub-committees be reported to the Cooperative Committee of the AAAS for consideration and appropriate action with special emphasis on the area of teacher education.

Members of the Committee:

Alfred Beck
George Glasheen
Morris Meister
Jerome Metzner, *Co-Chairman*
Philip N. Powers, *Chairman* (resigned)
Abraham Raskin, *Co-Chairman*
John Richardson

THE ABILITY TO RECOGNIZE AND APPLY SCIENTIFIC PRINCIPLES IN NEW SITUATIONS:

An Experimental Investigation in High School Biology and Chemistry * [1]

J. Harold Owens

New Haven State Teachers College, New Haven, Connecticut

PURPOSE OF THE INVESTIGATION

The purpose in this investigation is two-fold: (1) to study the relationship between the ability of high-school pupils to recognize scientific principles in test situations and the ability to apply these principles to problematic situations, and (2) to study the effects of directed teaching on the ability of these pupils to apply scientific principles to new situations, not previously employed in the teaching of the understanding of the principle.

* Paper presented at the Atlantic City meeting of the National Association for Research in Science Teaching, February 18, 1951.

[1] Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the School of Education of New York University. 1949.

QUESTIONS WHICH THIS STUDY WILL ANSWER

In this investigation the following questions were used as the basis for meeting the demands of the purposes stated above:

1. What is the relationship between the ability to recognize scientific principles and the ability to apply these principles to new situations?
2. What is the relationship between mental age and the ability to recognize and apply scientific principles to new situations?
3. Do these abilities have significant relationship with intelligence as measured by intelligence tests?
4. What is the relationship between sex and the ability to recognize and to apply scientific principles to new situations?
5. To what extent, if any, does instruction directed toward this end, affect the ability of students to apply scientific principles to new situations?
6. Is there any difference between intelligence levels and sex groups in the progress made after instruction?

DESCRIPTION OF THE CLASSES

The place of this investigation was the Greenwich High School, a public high school in Greenwich, Connecticut. The subjects used in this study were 296 high-school students. One hundred eighty of these students were engaged in the study of tenth-grade biology and 116 in the study of high-school chemistry. Table I below describes the classes studied.

DESCRIPTION OF THE TEACHING PERSONNEL

Since it was necessary to have represented two different grade levels in order to have a sufficient number of cases for statistical significance, and a wide range of mental ages, it was impossible for the investigator to conduct this investigation without the assistance of other teaching personnel. An experienced teacher of tenth-grade biology and another experienced teacher of twelfth-grade chemistry were selected to assist in conducting the investigation.

During the first semester of the school year (Group A—Biology at the tenth-grade level and Group C—Chemistry at the twelfth-grade level), were designated as *experimental* groups. Two other groups (Group B—Biology at the tenth-grade and Group D—Chemistry at the twelfth-grade level) were designated as *control* groups. These four groups were taught by the investigator.

During the second semester of the school year, the teaching phase of the experiment was repeated (Groups E and G—Biology at the tenth-grade level and Group I—Chemistry at the twelfth-grade level), were designated as *experimental* groups. Two other groups (Group F—Biology at the tenth-grade level and Group J—Chemistry at the twelfth-grade level) were designated as *control* groups. The two teachers who assisted the investigator performed the teaching during this second semester.

TABLE I

DATA CONCERNING THE DESCRIPTION OF THE CLASSES

Group	Grade	Subject	No.	Age Range in Yrs.and Mos.	Mean Age	I.Q. Range	Mean I.Q.
A	10	Biol.	27	13:10–18:2	15:4	85–125	101
B	10	Biol.	31	12:9–17:10	14:9	80–123	109
C	12	Chem.	28	15:11–18:11	17:7	90–127	112
D	12	Chem.	30	15:9–18:5	17:0	86–131	106
E	10	Biol.	30	13:9–17:4	13:9	74–116	102
F	10	Biol.	33	14:7–16:10	15:6	72–124	109
G	10	Biol.	29	13:9–17:3	16:1	74–120	102
H	10	Biol.	30	13:8–17:7	15:4	85–120	99
I	12	Chem.	30	16:2–18:5	17:3	90–120	109
J	12	Chem.	28	16:3–18:2	17:3	74–125	104

SELECTION OF SCIENTIFIC PRINCIPLES

This investigation was concerned with the ability of high-school pupils to recog-

nize and to apply scientific principles to problematic situations. Since it was planned to use subjects in both tenth-grade biology and twelfth-grade chemistry classes, scientific principles which are common to both biology and chemistry were selected.

The investigator studied the literature on the investigations of scientific principles and after covering the field thoroughly, the studies by Downing,[1] Pruitt,[2] and Robertson[3] were found to be outstanding. A jury of six outstanding leaders in the field of science education were selected to assist the investigator and the two teachers, for the selection of the scientific principles to be used in this investigation. The following scientific principles were selected:

1. The environment acts upon living things and living things act upon the environment.
2. All the higher forms of terrestrial life are dependent either directly or indirectly on the soil bacteria for their nitrogen intake.
3. Oxygen of the atmosphere is removed by animals and replaced by plants.
4. Before the seed that is planted in the soil can germinate, three factors must be present, namely oxygen, water, and heat.
5. Bacteria, by means of enzymes which they produce, cause chemical change in the substance from which they secure their nourishment.
6. Food, oxygen, and certain optimum conditions, moisture, and light are essential to the life of most living things.
7. The transfer of the micro-organism is from the infected to the non-infected individual and may be prevented by destroying the micro-organism.
8. Matter and energy can be transformed, but they cannot be created.
9. Every portion of matter can change its state by absorbing or replacing energy.
10. Protoplasm may be nourished only by food substances which have been reduced to liquid form by enzymes.

[1] E. R. Downing, "An Analysis of Textbooks in General Science," *General Science Quarterly* (May, 1928), XII, pp. 509–516.

[2] Clarence M. Pruitt, "An Analysis, Evaluation, and Synthesis of Subject Matter Concepts and Generalizations in Chemistry," Doctor of Philosophy Thesis, Columbia University, 1935. Published by the author, 1935.

[3] Martin L. Robertson, "A Basis for the Selection of Course Content in Elementary Science," unpublished Doctor of Philosophy Thesis, University of Michigan, 1934.

Construction of the Teaching Units

After the above ten scientific principles were selected, the units which were to be used in the teaching of the scientific principles to the tenth-grade biology classes and the twelfth-grade chemistry classes were constructed.

Many biology and chemistry textbooks, courses of study, pamphlets, work-books, visual aid materials, laboratory manuals, and teachers' manuals were studied for the purpose of constructing the teaching units. Science education journals and research investigations were studied for the criteria used for the selection and construction of these teaching units. The investigator and other selected teaching personnel selected the following units to be used in the tenth-grade biology classes. All ten scientific principles are encompassed in the four teaching units, designated here as four major problems with certain subordinate problems:

I. How does man obtain and use food?
   a. How does food help the body?
   b. What foods should man eat?
   c. How is food distributed in the body?
II. How does man control disease?
   a. How has man discovered the cause of disease?
   b. How does man prevent disease?
   c. How does man cure disease?
   d. How does man lessen pain?
III. How does man control plants?
   a. How does man make his surroundings more beautiful?
   b. How does man raise flowers?
   c. How does man care for house plants?
   d. How does man propagate plants?
   e. How has man improved plants?
   f. How has man controlled plants?
IV. How does man care for pets?
   a. What is the best pet?
   b. What can be learned from pets?
   c. How do pets reproduce?
   d. How are pets improved?

Using the same criteria, the investigator, with the teaching personnel who assisted with this study, the following units were constructed for teaching the ten scientific principles in the twelfth-grade chemistry classes. All ten scientific principles were encompassed in these teaching units:

I. What is the world made of?
   a. How does man recognize materials?

b. What kinds of changes surround us?
c. What chemical changes can man control through a knowledge of oxygen?
d. What chemical changes can man control through a knowledge of hydrogen?

II. How does man control and use water?
a. How is impure water made fit for various uses?
b. What can man do with water?
c. How does man make and use different kinds of solutions?

III. How does man obtain and use sulphur?
a. How does man prepare and use different oxides of sulphur?
b. How does man use sulphur?
c. What does man need to know about sulphur and its compounds?

IV. How does man prepare and use ammonia?
a. How does man obtain and use ammonia?
b. How does man prepare and use the oxides and acids of nitrogen?

DESCRIPTION OF THE TWO METHODS OF TEACHING

The control and experimental groups in both tenth-grade biology and twelfth-grade chemistry were allotted the same length daily class period, namely forty-eight minutes. Eight weeks were allotted to the teaching of an understanding of the ten scientific principles. However, the entire teaching phase of the investigation required sixteen weeks since the teaching phase of the experiment was conducted by the investigator the first semester and then repeated the second semester by the teaching personnel mentioned above.

A test based on these principles, constructed to measure the ability of students to recognize scientific principles, was administered both as a pretest and a final test to all the groups. Following this test, during the same class period, another test was administered. This test was constructed to measure the ability of students to apply scientific principles to new situations.

Following the pretests, four class periods were devoted to an explanation of the methods to be used in the classes. A simple demonstration was performed to illustrate the steps of the scientific method. Following this introduction, the students were made to realize that the proper attitudes were necessary before reliable conclusions could be drawn. The attitudes formulated by Curtis [1] were discussed.

The investigator and teaching personnel based their technique of teaching on these attitudes. Throughout the investigation the teaching personnel assisted the students in practicing reflective thinking by assisting the students in:

1. Devising and setting up experimental apparatus.
2. Using measuring instruments.
3. Recognizing errors.
4. Interpreting written passages.
5. Using the references and other sources of information.
6. Expressing their hypotheses and conclusions.
7. Conducting discussions.
8. Keeping records of demonstrations and experiments.

The teaching situation in both the control and experimental group consisted of a general overview of the unit selected. The students were asked to state in their own words the meaning of the unit. Next, a general content outline of the unit was developed on the blackboard. Following this, a bibliography based on the unit was passed to each student. While reading this, the students were required to keep notes and develop demonstrations which could be used to better solve the problems. Films and visual aids were used, when available. After completing a discussion of the problem, the students stated a solution to it.

The method used in the experimental class was the same as used in the control classes with the following additional techniques. During the extra time needed for these additional techniques, the control classes spent their time in study or observing safety films. Usually this extra period required two days in addition to the time spent in discussion of the problem or a total of eight days.

The students in the experimental classes were encouraged to discover applications of the data supplied and studied. These appli-

[1] F. D. Curtis, *Some Values Derived from Extensive Reading in General Science.* Teachers College Contributions to Education, No. 163, 1924, p. 48.

cations were listed in a separate notebook while the solution of the problem was being formulated. They were next asked to state applications of scientific principles to everyday living. They were requested to read additional references and to solve additional problems. Each student in the experimental group was requested to keep an additional notebook containing the applications of scientific principles to new situations and everyday living. A summary was made by each of these students showing how the application was related to the scientific principle. This summary took the following form: The experience described by the student was broken down into simpler elements. Each of these elements was analyzed and the common elements of all the experiences were listed. Following this analysis the cause of the experience was discussed and the students determined the relationship of the cause to the principle.

RELIABILITY OF THE TESTS

Following the construction of the test to measure the students' ability to recognize scientific principles, it was administered to fifty tenth-grade students in biology and to fifty twelfth-grade students in chemistry. Two weeks later, it was repeated to the same students. These students were not the students who participated in the learning phase of this investigation. Using the Pearson [1] Product Moment procedure the coefficient of reliability between the two sets of scores for the hundred students taking the test and then repeating it, was found to be 0.90.

After the completion of the administering the test to measure the students' ability to recognize scientific principles, the test to measure the students' ability to apply scientific principles to new situations was administered to the same students. Two weeks later this test was administered to the same students. The coefficient of reliability for the hundred students taking the test was found to be .60.

MATCHING THE EXPERIMENTAL AND CONTROL GROUPS

To determine the degree of effectiveness of directed teaching on the students' ability to recognize and to apply scientific principles to new situations it was necessary to match the groups participating in this investigation in order to keep each of the factors constant, while showing the relationship between other factors. The various groups were matched successively on the basis of intelligence scores, mental age, scores in initial information on tests, and chronological age respectively. Due to scheduling difficulties it was impossible to shift students in order to balance the sections, so the matching was done at the termination of the teaching phase of the investigation.

Two hundred and ninety-six students, divided between tenth-grade biology and twelfth-grade chemistry, participated in this investigation. The control groups included 152 of these students, and the experimental groups were composed of the remaining 194.

Table II shows the results of the successive matching on the basis of intelligence quotients, chronological age, and mental age respectively.

STATISTICAL TREATMENT OF DATA

The data obtained from the tests administered to the two hundred ninety-six stu-

[1] Henry E. Garrett, *Statistics in Psychology and Education*. Longmans, Green and Company, New York, 1932, p. 213.

TABLE II

Results of Matching Students

Basis of Matching	Number of Pairs	Range	Mean
Intelligence Quotients	103	74 mo.–125 mo.	105 mo.
Chronological Age	91	165 mo.–221 mo.	195 mo.
Mental Age	83	146 mo.–260 mo.	195 mo.

dents of this investigation were treated statistically for the following reasons:

1. To compare students of the control group with students of the experimental group in the ability
   (a) to recognize scientific principles, following instruction,
   (b) to apply scientific principles to new situations, following instruction,
   (c) to recognize scientific principles, following instruction, keeping the mental age constant,
   (d) to apply scientific principles to new situations, following instruction, keeping the mental age constant,
   (e) to recognize scientific principles, following instruction, keeping the intelligence quotient constant,
   (f) to apply scientific principles to new situations, following instruction, keeping the intelligence quotient constant,
   (g) to recognize scientific principles, following instruction, keeping the chronological age constant, and
   (h) to apply scientific principles to new situations, following instruction, keeping the chronological age constant.
2. To compare students in the experimental group above the mean mental age with students below the mean mental age, following instruction, in the ability
   (a) to recognize scientific principles, and
   (b) to apply scientific principles to new situations.
3. To compare students in the experimental group above the mean intelligence quotient with students below the mean intelligence quotient, following instruction, in the ability
   (a) to recognize scientific principles, and
   (b) to apply scientific principles to new situations.
4. To compare students in the experimental group above the mean chronological age with students below the mean chronological age, following instruction, in the ability
   (a) to recognize scientific principles and
   (b) to apply scientific principles to new situations.
5. To compare the girls of the experimental group with the boys of the experimental group, following instruction, in the ability
   (a) to recognize scientific principles, and
   (b) to apply scientific principles to new situations.

STATISTICAL PROCEDURE

The following statistical treatment of the data was used in order to meet the above aims of this investigation:

1. The standard error of the difference between the groups was determined by substituting in the following formula:

$$\sigma D_p = \sqrt{\frac{p_1 q_1}{N} + \frac{p_2 q_2}{N}}$$

   in which p=percentage of times a given event occurs, q=1−p and N=the number of cases and σD_p=the standard error of the difference between two uncorrelated percentages.[1]
2. The difference between the percentage of students that recognized and applied each scientific principle was determined.
3. The chances of a significant difference were determined for each principle.
4. The probabilities were combined for each of the ten scientific principles to determine if the collective results were significant of a real difference.[2]
5. The per cent level by which the value of X^2 is exceeded was determined.[3]

SUMMARY OF FINDINGS

The results of this investigation may be summarized as follows:

1. The experimental group had higher scores than the control group, following instruction, on the test constructed to measure the ability to recognize scientific principles.

2. The experimental group had higher scores than the control group, following instruction, on the test constructed to measure the ability to apply scientific principles to new situations.

3. The experimental group had higher scores than the control group on the test constructed to measure the ability to recognize scientific principles, keeping the mental age constant. However, these results are not statistically significant.

4. There was a significant difference, in favor of the experimental group, on the scores of the test constructed to measure the ability to apply scientific principles to new situations, following instruction, keeping the mental age constant.

5. The experimental group had higher scores than the control group, on the test

[1] Henry E. Garrett, Statistics in Psychology and Education (New York: Longmans, Green and Company, 1932), p. 213.

[2] E. F. Lindquist, Statistical Analysis in Educational Research (Boston: Houghton Mifflin Company, 1940), p. 40.

[3] Ibid., p. 36.

constructed to measure the ability to recognize scientific principles, following instruction, keeping the mental age constant.

6. The experimental group had higher scores than the control group on the test constructed to measure the ability to apply scientific principles to new situations, following instruction, keeping the intelligence quotient constant.

7. The differences between the control and experimental groups on both the test constructed to measure the ability to recognize scientific principles and the test to measure the ability to apply scientific principles to new situations, following instruction, were not of significance.

8. Students above the mean chronological age in the experimental groups obtained higher scores on both tests, following instruction, than students below the mean chronological age.

9. Students above the mean intelligence quotient in the experimental groups obtained higher scores on both tests, than students below the mean intelligence quotient.

10. There was no statistical difference between the boys and girls of the experimental groups on the scores obtained on the two tests constructed for this investigation.

CONCLUSIONS

Briefly, in conclusion, the results of this investigation, following instruction, as measured by tests constructed for this investigation, are as follows:

1. The students in this investigation had a greater ability to recognize scientific principles than to apply scientific principles to new situations.

2. There is a significant difference in favor of the experimental group in the ability to recognize and to apply scientific principles to new situations.

3. Students with mental ages above the mean mental age, intelligence quotients above the mean intelligence quotient and chronological ages above the mean chronological age, obtained higher scores on tests constructed to measure the ability to recognize scientific principles and to apply these principles to new situations, than did students with mean ages below these factors.

4. There was no statistical difference of significance between the boys and girls in this investigation in the ability to recognize and apply scientific principles to new situations.

RECOMMENDATIONS

The results of this investigation must be interpreted in terms of the conditions under which this study was made. So with this understanding, the investigator makes the following recommendations:

1. More tests, constructed to measure the ability to apply scientific principles to new situations, are needed because the tests were found to be limited as well as in error.

2. The problem-solving technique of instruction should be emphasized by teachers of science since both the control and the experimental group showed improvement in this investigation.

3. More research is needed on the development of the ability to apply scientific principles to new situations since these studies are limited.

4. More research is needed with students of higher and lower chronological ages, mental ages, and intelligence quotients since the results of one investigation cannot be decided as final.

5. This investigation should be repeated with other validated tests.

6. A longer period of time should be allotted to determine the effect of prolonged instruction on the ability to apply scientific principles to new situations since only one technique was used in this investigation.

A PROGRESS REPORT ON THE DEVELOPMENT OF A TWELVE-YEAR SCIENCE CURRICULUM IN THE NEW YORK CITY SCHOOLS *

ALFRED D. BECK

Science Supervisor, Junior-High-School Division, The Board of Education of the City of New York

THIS report is the sequel to the paper [1] pertaining to the organization of a twelve-year science sequence which was presented at the annual meeting of the NARST on February 26, 1950. This is a summary of the steps that have been taken during the past year.

It should be remembered that the Curriculum Committee of the Board of Superintendents appointed an Ad Hoc Committee in Science. This committee has six members: the science supervisors of the four school divisions (elementary, junior high, academic high, and vocational high), a chairman, and a secretary. The chairman is Dr. William H. Bristow, Director of the Bureau of Curriculum Research.

The function of the Ad Hoc Committee is to: (1) take stock of the ideas thus far advanced; (2) plan immediate next steps; and (3) provide administrative leadership in any science program that might develop. It began its work by organizing a series of four exploratory conferences to accomplish point one of its program. Members of the Curriculum Committee of the Board of Superintendents and the Ad Hoc Committee met on: March 22, 1950 with representative headquarters staff members (directors, *et al.*); April 27, 1950 with representatives of the governing council of the Federation of Science Teacher Associations; June 5, 1950 with college and New York State authorities in teacher education in the field of science; and June 19, 1950 with representatives of museums and other agencies in New York City that contribute to science education. Concurrently each science supervisor discussed the matter with the members of his divisional standing committee on science and other interested persons.

Major Premises for a Science Program. As a result of these conferences and discussions there emerged a number of major premises which seem likely to gain general acceptance. They are:

1. Certain common objectives of science teaching must permeate the teaching of science at all levels.[2]
2. The objectives of the science program should be in harmony with the common objectives of the total program of education and with the special objectives set up for each level of the school system.
3. The program and content of science learnings should be related to pupil experiences and to the stages of child development. They should help pupils to deal effectively with the concerns of everyday living.
4. The science curriculum should contribute to meeting the personal and social needs of children.
5. There should be an articulating committee to review and harmonize the work of all curriculum and standing committees in science.
6. While a common core of basic science experiences is desirable, there needs to be provision for curriculum adaptation to differences in classes, schools, committees, vocational interests, and capacities of pupils.
7. Provision should be made for keeping the content of the curriculum up-to-date with advances in science, new scientific methods, and changes growing out of technical and scientific developments.
8. Teacher and supervisor training corresponding to accepted objectives and re-

* Paper presented at the annual meeting of the National Association for Research in Science Teaching in Atlantic City, February 19, 1951.

[1] "Some Unanswered Questions Pertaining to the Organization of a Twelve-year Science Sequence." *Science Education*, April 1950, p. 176.

[2] "The Statement of Objectives," 46th Yearbook of the National Society for the Study of Education, 1947, pp. 28–29.

sponsive to varying needs must keep pace with the development of the science program.
9. Science curriculum experimentation in local situations as well as in pilot schools and districts should be encouraged and the results publicized if a good experimental design has been used.
10. Courses of study or syllabi should develop from the cooperation of curriculum workers, teachers, supervisors, and community leaders.
11. Curriculum development should be a continuous matter, built with both immediate and long-term needs in view.
12. A program of continuous evaluation is necessary if science education is to keep pace with changing needs and new developments.
13. Regents requirements need not necessarily be in conflict with objectives set up locally.

More Unanswered Questions. If all or most of the aforementioned premises are accepted, we will have to find answers to a number of problems which will then confront us. The following questions are typical:

1. What can be done to assure adequate emphasis on each accepted objective? What differentiation of stress is needed at each grade level?
2. On what basis are achievement expectancies to be established?
3. In what terms are we to picture the scope of science and its relation to other curriculum areas?
4. If science instruction at each level is to be related to the interest and growth characteristics of children and is, at the same time, to follow an organized program, what is to be the basis of the sequence of the program?
5. At what point in the school sequence is science to be taught as a subject? How shall it be related to a core curriculum?
6. How much of the time schedule should be devoted to science?
7. What shall be the place and purpose of laboratory work?
8. How can more effective use be made of resources and aids?
9. What kind of evaluation studies shall be undertaken?
10. What are the peculiar needs of teachers of each level for in-service training and supervision? How shall we assist those who are teaching science out of license?
11. At which points and at what times will the participation of laymen be most effective in helping to develop a science program?
12. How shall we initiate, coordinate, guide, and make use of research projects in the field of science education?

The Next Step. The Ad Hoc Committee believes it has achieved its first goal by thus having defined and delimited the problem before it. Its next goal is to have the premises brought before the teaching and supervisory staff for acceptance or modification. It also will seek a modus operandi for organizing curriculum committees and experimental curriculum revision. At the same time it will seek to organize a teacher training program and a program of evaluation. With this as its next goal, the Ad Hoc Committee has organized an all-day conference on the "Development of a Science Curriculum Program for Grades 1–12." This conference will be held on March 7, 1951. Its aim will be to secure from competent persons in the field of science education some specific, concrete suggestions for the implementation of the curriculum program. It is hoped that this procedure will not only produce the desired recommendations but that it will also exemplify the best utilization of the professional leadership available to us.

MINUTES OF NATIONAL COUNCIL FOR ELEMENTARY SCIENCE

BUSINESS MEETING, DETROIT, MICHIGAN

FEBRUARY 11, 1951

THE business meeting was called to order in the English Room of the Book-Cadillac Hotel at 9:30 a.m., Sunday, February 11, 1951, by Acting President, Julian Greenlee. After a preliminary discussion of the agenda, the minutes of the 1950 business session were read. It was recommended that the names of persons referred

to in the minutes be written uniformly. The secretary was instructed to make the necessary changes. With this correction, the minutes were approved.

George Mallinson, Coordinator of the State Representatives Program, presented a report (see files for mimeographed copy of the report) of the work he had done in selecting state representatives and in stimulating action in the states. It was agreed that a real and significant advance had been made by Mr. Mallinson in this phase of the NCES program. Four recommendations were made by Mr. Mallinson for "putting both NCES and the system of state representatives on a firmer footing." These were:

1. That within two weeks after the annual meeting, the persons who have not renewed membership be contacted by letter by the secretary, and they be urged to renew such membership. In this way, the stability of membership will enable the coordinator to have a more stable group of representatives.
2. That the coordinator be empowered to contact representatives immediately after the annual meeting.
   (a) to request their acceptance of the appointment for an additional term, and
   (b) to assure that they remain eligible for their appointment by renewing their membership.
3. That the coordinator be supplied with the names of members as soon as they join. In this way it may be possible to appoint persons as representatives in states not now represented. The most recent list of members contained names of persons from many states without state representatives. Yet, it appeared too late for use.
4. That the N.C.E.S. prepare some publication, or have some direct means for keeping in contact with its members. At present as stated by one representative, "All I can tell people when I ask them to join is that I'll send their dues to the treasurer."

Formal action was not taken separately on the first three recommendations. However, acting president Greenlee commended Mr. Mallinson for the fine work he has done. Miss Mary Browning moved and it was seconded by Jeff West, that the report be accepted and that NCES formally thank Mr. Mallinson (and Mrs. Mallinson) for the work done on the State Representatives Program. The motion was passed. Helen McCracken suggested and Rose Lammel reemphasized the importance of the State Representatives working through and in State Teachers Associations. Ned Bingham moved, and Helen McCracken seconded, that the State Representatives program be continued on the present basis. Motion passed.

The fourth of Mr. Mallinson's recommendations "That the NCES prepare some publication, or have some direct means for keeping in contact with its members" was introduced for discussion. (This problem was also presented by others in the meeting for inclusion on the agenda.) The major ideas were:

1. Clark Hubler suggested that we send well-known or carefully selected printed materials to each member one or more times during the year.
2. Jeff West proposed that a clear statement of our purposes be drawn up and distributed to our members. Such a statement would also include some statement of the purposes of science in the elementary school program.
3. Different persons suggested the following as possible materials to be bought and sent to members or procedures to be followed:
   (a) *Detroit Science Review* which includes summaries of some of the addresses given at the N.C.E.S. meeting on Saturday, February 10, 1951.
   (b) Elementary Science issue of *Science Education.*
   (c) U. S. Office of Education Elementary Science publications:
      1. Bulletin 1948, No. 4, Federal Security Agency, Office of Education. *Teaching Science in the Elementary School.*
      2. Bulletin 1949, No. 5, *Science Teaching in Rural and Small Town Schools.*
   (d) National Science Teachers Association Science booklets, *Experiments with Water and Experiments with Air.*
   (e) Reprints of magazine articles on elementary science.
   (f) N.C.E.S. might act as a clearing house for materials which are already available. For example, we might redistribute or loan courses of study, guides, etc., which come in from state departments of education and from city and county systems.
   (g) Upon the request of organized elementary science groups, send a proportion

of the dues from that region to the state representative to help carry on the program in the state.

Paul Blackwood pointed out that there was a sufficient balance in the treasury to warrant spending a substantial amount on materials or services for members.

Louise A. Neal pointed out the need for NCES to prepare a statement of basic purposes of elementary science in childhood education and suggested we give more attention to knowledge of child growth and development both in our programs and in what is written about science in the elementary school.

Clark Hubler moved and Bonnie Howard seconded that the president appoint a committee of four members, including the secretary-treasurer, to formulate a policy regarding materials and services to members. The motion was passed. Further discussion of the intent of the motion indicated that the committee is expected to decide what shall be sent to members this year and to make arrangements for sending it.

(Subsequent to the business meeting, President Julian Greenlee appointed the following committee: Clark Hubler, Chairman, Jeff West, Marian Young, and Ned Bingham.)

Nomination and election of officers: Glenn Blough, Chairman of the Nominating Committee, presented the following slate of officers for 1951–1952:

President.....Julian Greenlee
1st Vice President.....Paul E. Blackwood
2nd Vice President.....Marian Young
Secretary-Treasurer.....Ned Bingham
Board of Directors.....Richard Weaver
(1951–56)

Jeff West moved and George Mallinson seconded, that the secretary be instructed to cast a unanimous ballot for the slate as presented. The motion was passed.

Marian Young reported on her attendance at the U. S. Office of Education Fourth Conference of Leaders in Elementary Education. Miss Young worked with a study group interested in camping and outdoor education. Rose Lammel recommended that NCES continue to support this conference. She further moved that the Council express its appreciation to Miss Young for her attendance. The motion was seconded by Louise Neal and passed. Jeff West moved that a delegate be appointed by the president to attend the Fifth Conference of Leaders in Elementary Education. After a second by Ned Bingham, the motion was passed.

Jeff West gave a progress report on the Spring NCES meeting to be held in Seattle at the time of the meeting there of the Association for Childhood Education International. Members present suggested various names of persons who might participate in the meetings of NCES.

Rose Lammel, who coordinated the meeting held in Detroit on Friday, prior to the general NCES meeting on Saturday, reported. The meeting was designed to discuss ways people concerned with science in the elementary school relate science to the total program of the school. About 25–30 persons were present and they discussed such things as:

1. Role of the science consultant.
2. Role of the supervisor.
3. Evaluation of science programs.
4. Place of science guides in program planning.

Miss Lammel recommended that the program chairman for subsequent meetings consider forming panels around similar topics rather than grouping people according to primary, intermediate and upper grade levels.

Ned Bingham and Marian Young joined in recommending that such a meeting be made a regular feature of our National meeting. Miss Lammel was commended by the president for organizing the Friday meeting.

President Greenlee agreed to send letters to Dr. Emmett Brown, telling him of the meeting and letters to Mrs. Wachner and others who helped, to thank them for their part in making the program a success.

Paul E. Blackwood, Treasurer, reported

a balance of $543.29 as of February 11, 1951. This amount would be considerably changed after conference expenses are paid and new membership received. Jeff West moved and it was seconded by Glenn Blough that the Treasurer be authorized to pay all bills connected with the NCES meeting. The motion was passed.

The Chairman announced that the Executive Committee would meet directly after the business meeting. The meeting was adjourned.

OFFICERS OF THE NATIONAL COUNCIL FOR ELEMENTARY SCIENCE FOR 1951–52

President—Julian Greenlee
First Vice President—Paul E. Blackwood
Second Vice-President—Marian Young
Secretary-Treasurer—N. Eldred Bingham
Board of Directors—
Clarence M. Pruitt (1951–1952)
Katherine E. Hill (1951–1953)
Robert Cooper (1951–1954)
Louise Neal (1951–1955)
Richard Weaver (1951–1956)
H. Emmett Brown, Retiring President

REPORT OF THE PUBLICATIONS COMMITTEE

NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING

Meeting in Atlantic City, New Jersey, February 17–19, 1951

Papers given at the annual meeting of The National Association for Research in Science Teaching in Atlantic City, February 26–28, 1950 and presented to the Committee for publication were edited and submitted to the editor of *Science Education* for publication. Some of the papers appeared in the April, 1950 and October, 1950 numbers of *Science Education*. Others will appear in the March, 1951 number of this magazine.

Publications Committee
CHARLOTTE L. GRANT,
WILBUR L. BEAUCHAMP,
VADEN W. MILES, *Chairman*

NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING

FINANCIAL REPORT, FEBRUARY 18, 1951

RECEIPTS

Balance on Deposit	$862.72
Membership Fees	125.00
TOTAL	$987.72

EXPENDITURES

Social Hour—Chalfonte Haddon Hall	$ 24.75
Bank Charges	3.12
Bond for Treasurer	5.25
TOTAL	$ 33.12
NET BALANCE	$954.60

Respectfully submitted,
CLARENCE M. PRUITT,
Treasurer, NARST

TWENTY-FOURTH ANNUAL MEETING NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING

ATLANTIC CITY, NEW JERSEY, CHALFONTE-HADDON HALL

FEBRUARY 17, 18, AND 19, 1951

Officers

Betty Lockwood, President
The National Foundation for Infantile Paralysis, Inc.
120 Broadway, New York 5, New York

Clarence M. Pruitt, Secretary-Treasurer
School of Education
Oklahoma A. & M. College
Stillwater, Oklahoma

N. Eldred Bingham, Executive Committee
School of Education
University of Florida
Gainesville, Florida

J. Darrell Barnard, Executive Committee
School of Education
New York University
New York, New York

The program was quite flexible. Most of the meetings were devoted to the work of various committees. On Saturday night a group of NARST members went to Hackney's, famous for their seafood.

Sunday, February 18, 1951

Committee Meetings—10 a.m. to 12 noon and 1:30 p.m. to 4 p.m.
Elementary Committee (Bingham)—Roberts Room, Main Floor, Chalfonte
Junior High Committee (Glenn)—Roberts Room, Main Floor, Chalfonte
High School Committee (Anderson)—Roberts Room, Main Floor, Chalfonte
College Committee (Van Deventer)—Room 769, Haddon Hall
Atomic Energy Committee (Powers)—Room 471, Haddon Hall
Problem Solving Committee (Barnard)—Room 556, Haddon Hall
Membership Committee, Room 554, Haddon Hall

1:30 p.m.—Educational Trends (Meder), Blue Room, Chalfonte

4:30–5:30 p.m.—Social Hour, 13th Floor Hallway, Haddon Hall

7:00 p.m.—Banquet, Mandarin Room, Haddon Hall

Monday, February 19, 1951

9:30–10:30 a.m.
Elementary Committee—Roberts Room, Main Floor, Chalfonte
Junior High Committee—Blue Room, Main Floor, Chalfonte

10:30–12:00 noon
High School Committee—Blue Room, Main Floor, Chalfonte
College Committee—Roberts Room, Main Floor, Chalfonte

1:30–5:00 p.m.
Special Committee Reports—Blue Room, Chalfonte.

OFFICIAL MINUTES OF THE BUSINESS MEETING OF THE NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING

SUNDAY EVENING, FEBRUARY 18, 1951

Chalfonte-Haddon Hall, Atlantic City, New Jersey

Members present at the annual dinner meeting in the Mandarin Room were: F. A. Riedel, N. Eldred Bingham, Francis D. Curtis, Philip G. Johnson, Earl R. Glenn, S. Ralph Powers, Morris Meister, Alfred D. Beck, R. W. Lefler, W. Hugh Stickler, Vaden W. Miles, James C. Adell, John S. Richardson, Cyrus W. Barnes, Kenneth E. Anderson, Robert H. Carleton, Nathan A. Neal, Philip N. Powers, Thomas P. Fraser, William C. Van Deventer, W. W. E. Blanchet, George G. Mallinson, J. Harold Owens, J. Darrell Barnard, Elsa M. Meder, H. B. Crouch, M. L. Robertson, Lydia Elzey, Betty Lockwood, and Clarence M. Pruitt.

The annual business meeting proceeded as follows:

The official minutes of the last business meeting which was held in Atlantic City, New Jersey, February 26, 1950, and were published in the April, 1950, issue of *Science Education* were approved as published.

A report for the Auditing Committee of the Treasurer's book was made for the committee by Lydia Elzey. The other members of the committee were F. A. Riedel and H. B. Crouch. The report stated that the Treasurer's book had been audited and found to be in balance. It was moved and seconded that the report be accepted. Motion carried.

Treasurer Clarence M. Pruitt presented each member with a mimeographed statement showing the financial status of the National Association for Research in Science Teaching. It was moved and seconded that the report be accepted. Motion carried.

A report for the Publications Committee was made by Vaden W. Miles. Other members of the committee are Wilbur L. Beauchamp and Charlotte L. Grant. It was moved and seconded that the report be accepted. Motion carried.

The report of the Cooperative Committee on Science Teaching of the AAAS was made by our representative, George G. Mallinson. It was moved and seconded that the report be accepted. Motion carried. There was some discussion of the report.

The report of the Nominating Committee was made by Francis D. Curtis. Other members of the committee were G. P. Cahoon and Hanor A. Webb. The following list of names were proposed for officers for 1951–52:

President—Betty Lockwood
Vice President—J. Darrell Barnard
Secretary-Treasurer—Clarence M. Pruitt
Executive Committee—N. Eldred Bingham and George G. Mallinson

Miles made a motion that the report be accepted and that the Secretary be empowered to cast a unanimous ballot for those named by the nominating committee. The motion was seconded by F. A. Riedel. Motion carried.

There followed some discussion by Earl R. Glenn and R. W. Lefler on the relations of NARST and the National Science Teachers Association. Glenn is NARST consultant to NSTA. Glenn asked to be relieved of his position as consultant.

A business meeting was held on February 19 at 4 p.m. in the Blue Room, Chalfonte. There was considerable discussion relating to the publication of abstracts made by the various NARST committees of investigations in the teaching of science. A motion was made that certain abstracts and studies having to do with science education be published in the October issue of *Science Education*. The motion was seconded and carried. Such material for the October issue is to be sent to the Editor by mid-summer.

It was moved and seconded that this meeting decide on the time and place of the NARST meeting in 1952. Motion carried. Among the cities considered were Chicago, St. Louis, and Detroit. On the first ballot St. Louis and Chicago tied. St. Louis was selected on the second ballot and the time decided upon was Thursday, Friday, and Saturday following the February meeting of the ASCD in Boston.

At a meeting of the Executive Committee held later, and after consultation with a number of other members of NARST, the Executive Committee voted unanimously to reconsider the selection of St. Louis as a meeting place in 1952. The basis for this consideration was the fact that certain members of NARST could not attend meetings in St. Louis. Chicago was then selected as the meeting place by the Executive Committee. (The meeting will be held at the Congress Hotel in Chicago on February 14, 15, and 16, 1952.)

Plans were made by the Executive Committee for making this silver anniversary meeting a notable one. Barnard was named chairman of a committee to make arrangements on charter member recognition. Mallinson was named chairman of a committee on invitation to graduate students that might attend the Chicago meeting. Special invitations are to be made to officers of the Central Association of Science and Mathematics Teachers and Heads of the Science Departments of schools in the Chicago area, to attend the NARST meetings.

It was moved and seconded that the matter of appointment of a consultant to NSTA be delayed until such time as NSTA informs NARST of the duties of such a consultant. Motion carried.

Motion was made, seconded, and carried that Betty Lockwood represent NARST at the meeting of School Health Section of the American Public Health Association. This section is attempting an evaluation of the validity of the health content of school textbooks.

Metzner and Raskin were appointed to co-chairmen of the Atomic Energy Committee.

Respectfully submitted,
CLARENCE M. PRUITT,
Secretary

RECENTLY ELECTED MEMBERS OF NARST

Austin D. Bond
East Carolina Teachers College
Greenville, North Carolina

Mrs. Annie Sue Brown
Science Coordinator
Atlanta High School
Atlanta, Georgia

Will Scott DeLoach
Mississippi State College for Women
Columbus, Mississippi

Gordon M. Dunning
State Teachers College
Indiana, Pennsylvania

John J. Fisher
Department of Biology
Manhattan College
New York, New York

Ward T. Fletcher
School of Education
Florida State University
Tallahassee, Florida

William Cleland Forbes, Jr.
State Teachers College
Towson, Maryland

Willard Geer
Department of Physics
University of Southern California
Los Angeles, California

B. Frank Gillette
Director of Student Teaching
Stanford University
Stanford, California

Keith C. Johnson
Department of Science
Division 1–9
District of Columbia Public Schools
Washington, D. C.

Leland P. Johnson
Drake University
Des Moines, Iowa

Lyman C. Knight
Muskingum College
New Concord, Ohio

Haym Kruglak
Department of Physics
University of Minnesota
Minneapolis, Minnesota

Clarence H. Nelson
Michigan State College
East Lansing, Michigan

Clarence Louis Schloemer
Department of Biological Science
Michigan State College
East Lansing, Michigan

Harold S. Spielman
Department of Education
City College of New York
New York, New York

Francis J. St. Lawrence
Biology Department
Bristol High School
Bristol, Connecticut

Hugh B. Templeton
Secondary Science Supervisor
New York State Dept. of Education
Albany, New York

Nathan S. Washton
Biology Department
Queens College
Flushing, New York

George P. Zimmer
State Teachers College
Fredonia, New York

BOOK REVIEWS

GREENLEE, JULIAN. *Teaching Science to Children.* Dubuque, Iowa: Wm. C. Brown Company, Publishers, 1951. 57 p. $1.50.

Teaching Science to Children was prepared "to be used as a source book of science experiences for teachers of young children. The book deals with some specific examples of science experiences but should not be considered to be a syllabus of the science learnings important for little children. The interpretations which are made are for the benefit of teachers and are not necessarily appropriate for the children with whom he may be working. There is an attempt to put experiences in an order that is logical for children."

The chapter headings are as follows: (1) Understanding Children, (2) Children's Experiences with Living Things, (3) Children's Everyday Experiences, (4) Children's Experiences with Soils and Rocks, (5) Children's Experiences with Space Concepts, (6) Children's Experiences with Mechanics, (7) Children's Experiences with the Atmosphere, and (8) Children's Experiences with Temperature Controls.

The experiences seem to have been unusually well selected and are ones that children in most classrooms everywhere under some teacher guidance can understand and carry out. The approach

Recognizing the far reaching consequences science has for human society, these stimulating texts organize basic subject matter around problem areas having significance for young people in their everyday living.

NEW WORLD of SCIENCE
experiences in General Science
Burnett • Jaffe • Zim

BIOLOGY FOR BETTER LIVING
Boyles • Burnett

NEW WORLD OF CHEMISTRY
Bernard Jaffe

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NEW YORK 45 East 17 Street
CHICAGO 221 East 20 Street
DALLAS 707 Browder Street
SAN FRANCISCO 709 Mission Street

is practical, functional. Undoubtedly in-service teachers in every classroom utilizing science experiences will very much appreciate having such a book made available. They should find it an unusually fine aid in solving many of their everyday classroom problems in teaching elementary science. It is also an excellent source book for pre-service elementary teachers.

The reviewer considers it an unusually fine contribution to the literature of elementary science and it undoubtedly will serve a most useful purpose for many years to come.

The author is a professor of biology and physics at Western Michigan College of Education, Kalamazoo, Michigan. He is 1951–52 President of the National Council on Elementary Science, of which *Science Education* is the official publication. Long a recognized leader in elementary science education, Dr Greenlee is recognized for his sound, functional approach to teaching elementary science.

BLOUGH, GLENN O., AND HUGGETT, ALBERT J. *Methods and Activities in Elementary School Science.* New York: The Dryden Press, 1951. 310 p. $3.75.

Methods and Activities in Elementary School Science has been prepared for those courses which concentrate on the methods of teaching science. The authors have assumed that the student has acquired a subject-matter background in earlier science courses. Hence this book devoted itself in showing the student how to apply his science knowledge in the elementary school classroom.

The authors have attempted to make the book functional for the student not only during his course but also throughout his teaching career. A functional approach and treatment characterizes the book.

Objectives are stated in terms which are capable of achievement in almost any school situation. Much repetition of the applications of these objectives is made in the various science areas discussed. Activities have been planned to require only inexpensive, easily provised home-made materials. There are many illustrations and photographs that depict how elementary science is taught in many different classrooms. Simplicity and safety is stressed in all of the experiments described. Field trips, activities, and the use of audio-visual aids and community resources are described in detail.

Part One on Teaching Elementary Science has the following five chapters: Science in the Elementary School, The Objectives in Elementary Science, Helping Children Learn Science, Organizing the Science Program, and Problems and Questions about Teaching.

Part Two on Teaching Specific Science Areas has the following chapters: Ancient Animals and Plants, The Earth and Its Surface, The Sun and the Planets; The Constellations and the Galaxies, The Wind and the Weather, How Plants and Animals Grow, Living Things and the Seasons, The Behavior and Habits of Animals, The Human Body and How It Works, Conservation of Our Resources, "What's It Made Of?", Fire Prevention and Fire Safety, Heat and How We Use It, Atomic Energy and Its Uses, Machines and How They Work, Magnetism and Electricity, Sound and How We Use It, Light and How We Use It, and Aviation.

The appendix has an excellent bibliography listing professional publications for teachers, general subject-matter background books for teachers, state bulletins and courses of study in elementary science, sources of free and inexpensive materials, magazines for use in science teaching, film catalogs and film sources, listing of radio programs and recordings, experiment books for children, books on identification, and books for children and books for teachers on specific teaching areas.

Don't the contents of this book sound like just what so many elementary teachers need? Examination of the book and its use will more than confirm this expectation. Elementary science teachers are at last having made available to them the kind of professional aids that they so badly need. This and other similar publications reviewed in *Science Education* are proof of this. The active and widespread use of this book and other materials reviewed could almost revolutionize elementary science teaching.

Mr. Glenn O. Blough, senior author of this book, is well known to readers of *Science Education* as one of America's foremost leaders in Elementary Science. He is specialist for elementary science in the United States Office of Education and is the co-author of "Discovering Our World," a well known and widely used series of elementary science texts. He is also co-author with Paul E. Blackwood of *Teaching Elementary Science* and *Science Teaching in Rural and Small Town Schools.*

Mr. Albert J. Huggett is Associate Professor of Education at Michigan State College.

WELLS, HARRINGTON. *Elementary Science Education in American Public Schools.* New York: McGraw-Hill Book Company, 1951. 333 p. $3.75.

This is a textbook for elementary school methods classes in science. It should also serve well as a reference book for in-service teachers who are in need of information regarding progressive techniques and philosophy in teaching elementary science.

Emphasis is placed throughout the book on social science—natural science integration throughout the grades.

Part I, *Theory and Practice* discusses the need for progressive classroom leadership, trends and methods, philosophy, the elementary classroom laboratory nature study in early childhood, science in the upper elementary grades, unit development, departmentalized science in grades seven and eight, the junior high school science laboratory, and laboratory experiments with plants.

Part II, *Resource Aids* discusses: Audio-visual sources of supply, bibliography for teachers, sources and annotations: booklets, pamphlets,

pictures and posters, classic nature art for the primary-elementary classroom, conservation of natural resources agencies, dramatic playlets useful in primary-elementary science education, elementary school songs about nature, graded elementary science readers, instrumental and vocal phonograph recordings, magazines useful in elementary science education, materials and workbooks for the primary-elementary grades, and supplies and apparatus for departmentalized science.

Teachers preferring the title "Nature Study" rather than "Elementary Science" for pre-junior high school will especially appreciate this book. The author advocates that work in the primary grades emphasize plants and animals as the most natural approach. Also Professor Harrington approves an animistic or anthropomorphic approach to plant and animal study in these grades, but would not carry such explanations to an extreme. He believes that as the child matures he may safely be led to distinguish fact from fancy. Justification for this "fancy" or fairy tale approach is based by the author on the belief that (1) children have a more natural interest in plants and animals, e.g., stories in which a cat talks to a dog, and (2) the CBS popular radio program, "Let's Pretend." In summary Professor Harrington says, "Let us then deal with child loved fairy tales as *fairy tales;* just for the pure intellectual fun of it, with knowledge and intention, just as millions of American fathers and mothers do in their daily lives. This in itself is part of child maturation, of preparation for life. Used thus, fanciful tales have a legitimate place in early science training." Accepting this philosophy, Nature Study teachers will find the rest of the text most satisfactory. Elementary science teachers, not accepting this philosophy, will find many useful and valuable suggestions in the rest of the book. Many useful classroom techniques, types of activities, and sources of materials are suggested.

Davis, David R. *The Teaching of Mathematics.* Cambridge 42, Massachusetts: Addison-Wesley Press, Inc., 1951. 415 p. $4.50.

The author of *The Teaching of Mathematics* says that his experiences have shown (1) that in order to teach a subject effectively one needs to know it thoroughly, be vitally interested in its study, and systematically organize the instructional material, (2) that techniques and teaching procedures should be directly associated with the study of subject matter, and (3) that most teachers want practical assistance in preparation for their classroom activities and other duties. This book is designed for a one semester course in the teaching of mathematics. It is based on the author's many years of experience in teaching secondary and college mathematics and in the training of mathematics teachers. The author is professor of mathematics at the New Jersey State Teachers College at Montclair, New Jersey.

Consideration is given to aims and problems of teaching, techniques of teaching, arousing and maintaining interest, aids and trends, tests and measurements, organization and treatment of subject matter, seventh and eighth year mathematics, non-traditional courses in mathematics, a first course in algebra, a first course in plane geometry, a second course in algebra, a first course in mathematical analysis, algebraic operations and our number system, junior college mathematics, professional duties and teacher preparation, and supervision and improvement of instruction.

Not only does the book contain many excellent suggestions of great value to pre-service and in-service teachers of mathematics, but there are many splendid suggestions for the science teacher.

Frasier, George Willard. *An Introduction to the Study of Education.* New York: Harper & Brothers, 1951. 319 p. $3.00.

An Introduction to the Study of Education gives an overview of the whole field of education—its aims, organization, and procedures. It is designed to serve as a text for the first course in education for those persons who have selected teaching as their future vocation. For this purpose the text seems most suitable. As the teacher of such a course, the reviewer considers it the most suitable text for a course of this kind that he has examined. The textual material has been well selected, is presented in a most readable style that the editor John Guy Fowlkes describes as "scholarly but not stuffy, interesting but not flippant, substantial but not teeming with useless minutiae and out of date statistics."

The author is well-known as the former president of Colorado State College of Education, Greeley, Colorado, and presently professor of education at Stanford University. Dr. Frasier traces the historical development of education and its philosophy in a democracy, along with its organization and administration. He treats the various levels of teaching, showing the different qualifications and preparation for each. Child growth and development are discussed with attention to the learning process, individual differences, intelligence tests, guidance, and the intricacies of the teaching process. The conclusion is a practical summation of the types and availability of teaching positions, ethics, compensation and other information to help the student answer the question, "Shall I be a teacher?" At the end of each chapter is an excellent bibliography of related reading and suggestions of things to do.

Kilpatrick, William H. *The Education of Man: Aphorisms by Heinrich Pestalozzi.* New York: Philosophical Library, 1951. 93 p. $2.75.

This is a collection of pithy sayings and aphorisms designed to present to the serious reader some of the underlying basic principles of the philosophy of education of the renown Swiss. Taken from the vast material of Pestalozzi's writings, much of which was never made available in the English language. Pestalozzi un-

questionably is one of the most remarkable men of modern times. In his day Pestalozzi (1746–1827) was one of the most widely acclaimed teachers of the young.

There is an introduction by William H. Kilpatrick. Examples of a few of the aphorisms:

The smile of happiness, the tear of sympathy, are both denied the world of beasts. They are the privilege of mankind alone.

The world is full of useful people, but void of those who will give the useful man a job.

I know of no better medicine against suffering injustice than to bear it in silence.

There are always plenty of pretexts in this world for acting against our better knowledge or our conscience.

From my earliest boyhood I was impressed with the sacrosanct character of humble service from the ground up. But now I have learned that if one would accomplish miracles, one must serve humbly, even when one's hair is gray.

God ordains that mankind should learn the most important things at the fireside.

Without love, neither the physical nor the intellectual powers of the child will develop naturally.

The heart alone can guide the heart.

You must bend your children in the direction they must go almost before they know the difference between right and left.

The instruction of the young must in every aspect be directed more toward developing their abilities than toward the enrichment of their knowledge.

Quiet sympathy touches the heart more than words.

When people inflict great wrongs upon one another, you are likely to hear it said afterward, "If only they had talked it over first."

It is a well-known fact that of all tyrants the smallest are the cruelest; but of all petty tyrants school tyrants are the worst.

If a pond grow foul, what if a few dozen fish in it remain healthy?

You will always find that the man who has experienced sorrow and trouble is apt to be more of a man than the fellow who has had none—that he can do more, and that he will be more.

In the deepest abyss of injustice that you will always find the most painstaking care to prevent a semblance of justice.

Least of all is liberty the right to do what is not prohibited by law.

Truth rests on a rock as its sole foundation. A lie, however, always takes its position behind a lot of reasons, in which it hides as it were behind a heap of pebbles.

A wobbly table is all but useless; but a faltering man is even less useful by far, for he is harder to support.

Nothing so much disconcerts the arrogant tyrant as when those hitherto under his thumb begin to assert their own rights.

The black man paints the Devil white, but the white man sees him black.

Great men will never tell you how great they are.

Fashions are usually seen in their true perspective only when they have gone out of fashion.

All man's life on earth is but a stage in his education in which his powers and aptitudes are developed for all eternity in accordance with the Creator's will.

CHILDS, JOHN L. *Education and Morals.* New York: Appleton-Century-Crofts, Inc., 1950. 299 p. $2.75.

Few books in American education published in recent years have received higher praise than that accorded to *Education and Morals.* Many have compared it with John Dewey's classic *Democracy and Education.* It is indeed a significant contribution on educational philosophy. Many readers have had difficulty in gaining a complete comprehension of the writings of John Dewey. They should not experience this difficulty in reading *Education and Morals.* The author presents the present as an age of crisis and revolution, a period of profound social and cultural transition. American education is seen as in a position to make important and significant educational choices. Professor Childs places great emphasis on *Morals* as involved in one of the choices to be made. The democratic way of life, like every other way of life, has to be learned.

Part One discusses the Moral Nature of Deliberate Education: Characteristics of Deliberate Education; Society and Education; Substitutes of Mundane Evaluations in Education; Nature and Education; The Alternative of Classical Humanism; Parents and Teachers in a Period of Cultural Transition. Part Two discusses Education and the Values of Democratic Civilization: The Morality of Primary Experiences; The Morality of Inquiry; The Morality of an Open Society; The Morality of Function; The Morality of Community; and the Morality of Patriotism.

HAY, CLYDE LEMONT. *The Blind Spot in American Education.* New York: The Macmillan Company, 1950. 110 p. $2.00.

The 1948 decision of the U. S. Supreme Court in the Champaign Case brought into sharp focus the question of religious teaching in public schools. By an 8 to 1 decision the Court declared unconstitutional the practices of weekday religious doctrinal training in the public schools of Champaign, Illinois.

The author, for many years a Methodist minister, believes that a type of religious education can be worked out which will entirely harmonize with the beliefs of Protestants, Catholics, and Jews and at the same time be in harmony with the Constitution and the law. He believes a "blind spot in American education" is the lack of religious education. American students are often religiously illiterate. Our growing juvenile delinquency (note recent narcotic investigations) increased divorce rate, and dangers of Communism are all partly the result of "this blind spot."

Educational Policies Commission. *Moral and Spiritual Values in the Public Schools.* Washington, D. C.: National Education Association, 1951. 100 p. $1.00.

Since the time of McGuffey there has been less emphasis placed on moral and spiritual values in American public schools. Many educational leaders believe this lessened emphasis has had unfortunate consequences in American life. The home has been even more negligent. Witness the present moral decadence by those in places of great responsibility in government. What can the schools do about this vital problem? This report discusses the problem and makes some suggestions.

The American people are agreed on certain values: human personality—the basic value, moral responsibility, institutions as the servants of man, common consent, devotion to truth, respect for excellence, moral equality, brotherhood, the pursuit of happiness, and spiritual enrichment.

Various sanctions can be illustrated in school situations: justice, law, property rights, integrity, group approval, authority, and guidance.

Mann, Horace. *Seventh Annual Report Covering the Year 1843; Eighth Annual Report Covering the Year 1844.* Washington, D. C.: Hugh Virch-Horace Mann Fund of the National Education Association. 199 p.; 136 p. $1.00 each.

These are facsimile editions. Horace Mann was undoubtedly one of America's foremost educators. His twelve annual reports as Secretary of the Board of Education of Massachusetts shall always be accorded as one of the great contributions to American education. Mann's greatness as a leader in education is attested in the two above reports.

The Seventh Report records Horace Mann's observations in European Schools, especially the German, and contrasts American schools with them—a report leading to the famous controversy with the Boston schoolmasters.

The Eighth Report considers the value of local and county educational institutes, the value of music, the use of the Bible, and the employment of women teachers.

One cannot but marvel and be amazed at Mann's description of the accomplishment of the German schools and at the depth and breadth of training of German teachers. But with all of his praise for the German School system, Mann in a penetrating analysis, senses the great, and one might also say fatal, weakness in German education.

The following quotation from Mann describes a condition in his day that does not seem to have been actually greatly changed down to the present day.

"To the above I may add I found all of the teachers (German) whom I visited, to be alive to the subject of improvement. They had libraries of the standard works on education—works of which there are such great numbers in the German language. Every new book of any promise was eagerly sought after; and I uniformly found the educational periodicals of the day, upon the tables of the teachers. From the editor of one of these periodicals I learned that more than thirty of this description are printed in Germany. And that the obscurest teacher in the obscurest village is usually a subscriber to one or more.

"A feeling of humiliation overcame me, as I contrasted this state of things in my own country, where of all of the numerous educational periodicals which have been undertaken within the last twenty years only two of any length of standing, still survive. All of the others have failed through indifference of teachers and the apathy of the public. One of the remaining two—that conducted by F. Dwight, Esq., of Albany, N. Y.—would probably have failed ere this, had not the Legislature of the State generously come to its rescue, by subscribing for twelve thousand copies—one to be sent to each school district in that great state. The other paper, as it is well known, has never reimbursed to its editor, his actual expenses in conduction of it."

Horkheimer, Mary Foley, and Diffor, John W. *Educators Guide to Free Films.* Randolph, Wisconsin: Educators Progress Service, 1951. 462 p. $6.00.

This is the eleventh edition of one of America's outstanding service publications. It lists titles and sources of free films of more interest to teachers of science than for any other teaching area. A number of those listed under applied arts, health education, and social studies including geography are equally useful to the science teacher. There is a description of each film, stating running time, and whether black or color, and whether silent or sound. Films are then listed alphabetically according to title, then listed according to subject matter, and finally there is a source and availability index which also indicates whether transportation is to be paid one or both ways.

Under general science there are 155 titles, of which 32 are new; 106 in chemistry, of which 27 are new; 95 in physics, of which 2 are new; and 51 in biology, of which 12 are new.

Cantril, Hadley. *The "Why" of Man's Experience.* New York: The Macmillan Company, 1951. 198 p. $2.75.

A new interpretation of the behavior of man is presented in a brief, non-technical manner. After a brief discussion of the relationship to psychology of the scientific method, the book discusses what seems to be the universal goal of people as human beings. After suggesting *why* and *how* this human characteristic has developed, it outlines the ways in which man creates his own environment in order to carry out his purposes.

Here are some of the questions the author attempts to answer:

What accounts for man's anxieties and his expectancies?

How and *why* does he develop attitudes and prejudices?

Under what conditions do these change?

How and *why* does the individual build up his own psychological assumptive world?

Why are some social relationships satisfying?

What are the psychological conditions that make for a sense of happiness?

What are the bases for friendship and loyalty?

Does man have a freedom of choice?

An outstanding characteristic of man is his ceaseless striving. Irrespective of the particular culture in which he is born, irrespective of the particular groups with which he may be identified, man seems to carry on constantly in some purposive way. Although man is an animal, many of his characteristics are not shared by any other animal. The outstanding characteristic of man is his capacity to sense value attributes in his experience and to seek an enhancement of these value attributes through participation in new situations.

Altogether this book possesses outstanding merit and is so interestingly and challengingly written as to hold the reader's interest throughout. It is an excellent treatise on the development of man's psychological reactions.

ASSOCIATION FOR SUPERVISION AND CURRICULUM DEVELOPMENT. *Better Than Rating.* Washington, D. C.: Association for Supervision and Curriculum Development, National Education Association, 1950. 83 p. $1.25.

This is the report of a Commission on Teacher Rating of the ASCD. All phases, pro and con, of teacher rating are discussed. Chapter I discusses Teacher Rating: Problems and Issues; Chapter II, How Teachers Accomplish Best Results; Chapter III, Evaluation: One Aspect of Professional Growth; Chapter IV, Analysis of Current Teacher-Rating Practices; Chapter V, How Rating Affects the School Program; Chapter VI, A Better Way.

The better way is a comprehensive program of educational appraisal, as distinct from mechanical types of rating devices. The process is a cooperative enterprise involving pupils, school people, and lay citizens. The program of appraisal starts where teachers are and goes from there. The program of appraisal is continuous and comprehensive. Evidences of individual growth and development are needed.

WOODBURNE, LLOYD S. *Faculty Personnel Policies in Higher Education.* New York: Harper and Brothers, 1950. 201 p. $3.00.

This book is an intensive examination of existing faculty personnel policies. It is based on a study of nearly fifty representative institutions of higher learning—endowed universities, state universities, and liberal arts colleges. Beginning with the basic problem of appointments, the author carefully evaluates the current policies in matters of promotion, salary opportunities in teaching and research, tenure, conditions of work, staff planning, and organization.

BENJAMIN, HAROLD (Editor). *Democracy in the Administration of Higher Education.* New York: Harper and Brothers, 1951. 240 p. $3.00.

This Tenth Yearbook of the John Dewey Society relates the whole problem of higher educational administration to a major responsibility of colleges and universities.

The fourteen chapters are contributed by twelve different writers. A few of the chapters are: Selecting and Appraising Personnel by Gladys A. Wiggin; Studying the Students and Their Communities by Harold C. Hand; Selecting and Developing Appropriate Institutional Activities by R. Lee Hornbake; and Evaluating Some Efforts to Achieve Democracy in an Administration by Edward J. Sparling.

SMITH, B. OTHANEL, STANLEY, WILLIAM W., AND SHORES, J. HARLAN. *Fundamentals of Curriculum Development.* Yonkers, New York: World Book Company, 1950. 784 p. $4.50.

Principles and procedures of curriculum development at any school level are discussed. It deals with problems common to all curriculums—elementary, secondary, or junior college. The authors emphasize human-relations, principles, and techniques as they relate to curriculum change. The best in contemporary theory and practice are utilized in the diagnosis of the school—community situation, tailoring the curriculum to the community, and the public-relations aspects of curriculum changes. The authors advocate a program of curriculum development that emphasizes the concept of cultural reintegration, the reconstruction of values, and the development of discipline in effective habits of thinking.

Altogether this seems to be an unusually fine book on curriculum development. Persons interested in planning curriculum changes or in knowing what are the latest trends will profit from reading this outstanding treatise. The authors are professors of education at the University of Illinois.

FROEHLICK, CLIFFORD P. *Guidance Services in Smaller Schools.* New York: McGraw-Hill Book Company, Inc., 1950. 352 p. $5.00.

Most of the high schools of this country may be classified as small high schools. Guidance problems in these smaller schools should have numerous differences from those found in large metropolitan high schools. By and large it may also be said that guidance needs in smaller high schools have been less effectively met than in the larger schools. Several factors are likely responsible for this difference. Smaller schools have less well-trained guidance persons; the

guidance-problem has loomed larger in the larger schools; less material has been available for guidance workers in smaller schools. Hence this book should fill a very great need of the smaller schools. Many principles of guidance and needs of youth are similar in all types of schools. The author discusses most of the aspects of guidance with special references and applications made to smaller schools.

CRONBACH, LEE J. *Essentials of Psychological Testing.* New York: Harper & Brothers, 1949. 475 p. $4.50.

Essentials of Psychological Testing is a new text in general principles designed to give the beginning students basic concepts rather than a catalog of existing tests. On the other hand numerous tests are introduced in detail, presented primarily as a means of illustrating significant principles.

Part I presents basic concepts: who uses tests, purposes and types of tests, interpreting test scores, how to choose tests, how to give tests. Part II describes a number of tests of ability, and Part III discusses testing of typical performances.

MICHEELS, WILLIAM J., AND KARNES, M. RAY. *Measuring Educational Achievement.* New York: McGraw-Hill Book Company, 1950. 496 p.

This book is intended for teachers, especially the busy teacher and the inexperienced teacher. For this reason less attention is paid to standardized tests, not because the authors do not believe of their vital importance in any effective program of evaluation, but because the typical teacher uses few, if any, standardized tests. Hence the major emphasis in the book is on the "how" of making and using tests and other instruments of appraisal. The "what" and "why" have not been neglected, however. Teachers following the suggestions offered in this book should find his evaluations more effective and meaningful. Many practical suggestions are given, often through numerous illustrations.

Chapter headings include: an introduction to measurement, kinds and types of evaluating instruments, purposes of evaluation, what makes a good test, general principles of test construction, multiple-choice items, true-false items, matching items, recall items, object tests, manipulative-performance tests, observation and evaluation, evaluating major projects, interpreting test data and assigning marks, analyzing and improving tests, and improving your instruction.

TRAVERS, ROBERT M. *How to Make Achievement Tests.* New York: The Odyssey Press, 1950. 176 p.

This is one of the most practical texts that the reviewer has examined. Its main purpose is to help teachers develop the types of evaluation instruments that are known as objective tests of achievement. A secondary purpose is to provide teachers with a technique for defining educational goals. Emphasis is placed on the fact that objective tests usually measure only a few of the many outcomes of most educational programs. It is an excellent book for those in-service teachers who would like to develop better and more effective testing procedures. It would also serve most excellently as a text in a college course on tests and measurement.

GREENE, HARRY A., JORGENSON, ALBERT N., AND GERBERICH, J. RAYMOND. *Measurement and Evaluation in the Public School.* New York: Longmans, Green and Company, 1950. 639 p. $4.00.

The general background and methods of educational measurement and evaluation are presented in the first four chapters; chapters 5 to 8 present achievement tests; chapters 9 and 10 present intelligence tests and their use; chapters 11 and 12 personality tests and their use; chapters 13 to 21 tests in subject matter fields; chapters 22 and 23 statistical methods necessary for appropriate use of tests and the interpretation of results; chapter 24 gives a general summary on the broad uses of test results.

This revised edition of a text first published in 1942 would serve excellently as a basic text in a course in tests and measurement or for the use of in-service elementary teachers.

BURKE, ARVID J. *Financing Public Schools in the United States.* New York: Harper & Brothers, 1951. 584 p. $4.50.

Financing public education is a serious problem. In the face of higher taxes and the demands of a war economy, public education is likely to be very much neglected. Faced with a greater need for increased legislative appropriations because of the large increase in enrollment—actual and potential, the increased cost of school supplies, the need of more teachers, and the need of bringing teachers' salaries into line with the pay of unskilled or semi-skilled workers—the legislatures have been hesitant and have often refused to appropriate the needed funds. This book discusses and appraises the present situation and offers guidance as to what can be done so that schools may receive the needed financial support to meet at least minimum needs.

FRENCH, WILL, HULL, J. DAN, AND DODDS, B. L. *American High School Administration: Policy and Practice.* New York: Rinehart and Company, Inc., 1951. 625 p. $5.00.

The authors state as their belief that secondary education should be an instrument of democratic policy in the United States of America. Its primary obligation is that of helping all boys and girls to grow into young men and women who are mentally and physically fit, who will become good homemakers, competent workers, and active, socially conscious citizens.

This book attempts to acquaint students of secondary education with not only the organization and administration of fundamental policies now in effect in high schools and with the practices by which these policies are implemented but also to appraise their usefulness in the post-war period.

Major areas discussed by the authors include: the executive function and youth education; staff personnel relationships, responsibilities, and organization; the principal and the educational program; the principal and pupil-personnel activities; the principal and the high school plant; and the high school and its community.

YEAGER, WILLIAM A. *School-Community Relations.* New York (31 West 54th Street): The Dryden Press, 1951. 464 p. $4.75.

This is the revision of a book first published in 1939. Agencies and processes which bring home, school, and neighborhood community into usefully functional relationship are described. The need and advantage of utilizing community resources by the school and classroom teacher is being increasingly recognized. The author has emphasized the functional utilization of the resources of the neighborhood. There are a number of pertinent charts and graphs. Contents include the following parts: (1) Public Education and Community Interest; (2) Fundamentals of School-Community Relations; (3) The School's Responsibility; (4) Cooperating Agencies in the Community; (5) Organization and Administration; and (6) Building a Constructive Program.

MONTAGU, ASHLEY. *Statement on Race.* New York (20 East 70th Street): Henry Schuman, Inc., 1951. 172 p. $2.00.

Statement on Race not only incorporates the most advanced findings of scientists from many nations, it translates those findings into simple terms any general reader can understand. Misconceptions about race have bred much intolerance and caused much misery. *Statement on Race* is based upon the famous UNESCO official "Statement by Experts on Race Problems" and is written by the man who drafted and edited the UNESCO statement. The UNESCO statement was the fifth and final draft of statements by representatives from eight nations—physical anthropologists, sociologists, social psychologists, and ethnologists. In this book, Ashley Montagu uses each statement of the UNESCO statement as a text for an entire chapter amplifying the major points in easily understood summaries of the basic scientific findings.

GEBHARD, BRUNO. *Discipline and Educational Health.* Cleveland, Ohio (8911 Euclid Avenue): Cleveland Health Museum. 22 p. $.25.

This is the second printing of a report of the third health education workshop conducted jointly by Cleveland teachers and the Cleveland Health Museum Committee on education. Teachers and parents will find some practical suggestions regarding discipline.

SYMPOSIUM. *Who Says So?* Cambridge, Massachusetts (5 Chauncy Street): Civic Education Project, 1951. 61 p. $.60.

This pamphlet tells how a group of senior high school students learned about public opinion and used it.

Public opinion, though one of the greatest forces in the world, is one of the hardest to predict. Sometimes it is made by majorities, sometimes by minorities, sometimes it is good, and sometimes it is bad. The pamphlet discusses who makes public opinion, a project studied by high school students. The place of movies, radio, the press in forming public opinion are analyzed. The measurement of public opinion and how to set about forming public opinion are other aspects discussed.

EDUCATIONAL POLICIES COMMISSION. *Education of the Gifted.* Washington, D. C.: National Education Association, 1950. 88 p. $0.35.

American society needs its ablest members in positions of leadership and influence. A considerable proportion of the potential abilities of gifted individuals is at present lost to society through underdevelopment, underuse, or misuse. The difference between the gifted and ungifted is relative and not discrete. It has often been difficult to identify the gifted. In general the "highly gifted" are those individuals in the top one per cent of the total population and those as "moderately gifted" who are within the top ten per cent. Many obstacles are in the way of giving the gifted the kind of education they should have. But in most all instances much can be done through program enrichment.

EDUCATIONAL POLICIES COMMISSION. *Point Four and Education.* Washington, D. C.: National Education Association, 1950. 27 p. $0.20.

Much has been heard about the Point Four Program since President Truman's advocacy of such a program in his inaugural address on January 20, 1949.

Point Four Program is a comprehensive strategy in which the American government seeks to bring peace to all men and to insure the survival of human liberty. It is based on seven great realities confronting the whole free world:

(1) Owing to the advance of science and technology, distance has reduced the earth to a neighborhood; (2) the colonial peoples are rising; (3) approximately two-thirds of the people of the earth are caught in a vicious circle of ignorance, poverty, disease, and hunger; (4) a life of economic security and well-being is technically possible for all men; (5) war threatens

the very survival of civilization; (6) the whole world is threatened by a powerful and ruthless totalitarian movement—Soviet Communism; (7) in terms of industrial strength and military potential our country is the most powerful state in the world.

SYMPOSIUM. *Current Issues in Higher Education, 1950.* Washington, D. C.: National Education Association, 1951. 253 p. $2.00.

This volume includes the major addresses, official group reports and resolutions of the Fifth Annual National Conference on Higher Education held at Chicago, Illinois, April 17–19, 1950. There is also a supplement concerning the mobilization of higher education to meet the current emergency.

Major parts of this report discuss: A Challenge to Higher Education; The Student in Higher Education; Educational Programs in Higher Education; Evaluation of Current Programs in Higher Education; The Teacher in Higher Education; and The Organization and Administration of Higher Education.

DEPARTMENT OF RURAL EDUCATION. *County Educational Leadership.* Washington, D. C.: National Education Association, 1950. 19 p. $0.50.

This is a summary of the 1950 yearbook of the Department of Rural Education, *The County Superintendent of Schools in the United States.* Thirty-five states require previous teaching or administrative experience. Selection is made by appointment in 20 states. The doctor's degree is no longer an oddity among county superintendents. A few counties pay salaries of $10,000 or more, 250 have set salaries of $6,000 or above, and in eleven states the median salary is $5,000 or more.

AHLBERG, CLARK D., AND HONEY, JOHN C. *Attitudes of Scientists and Engineers About Their Government Employment.* Washington 6, D. C. (1785 Massachusetts Avenue, N.W.): Syracuse University, Washington Research Office, 1951. 223 p.

This is Volume I of a study made by The Maxwell Graduate School of Citizenship and Public Affairs of Syracuse University. One of the major purposes of the study was to determine the opinions about their government employment, as well as their reasons for leaving their government laboratory positions, of a large group of scientists and engineers who voluntarily left their positions during the year 1948 in order to provide the bases, in so far as possible, for corrective administration of the government's research and development programs. A total of 335 (49.8 per cent) responses were received. A few of the findings included:

ESPECIALLY LIKED ASPECTS OF LAST GOVERNMENT POSITION

1. Desirable working conditions..... 36.2%
2. Competent, considerate, and desirable co-workers and supervisors..... 35.5%
3. The particular project or general type of assignment worked on..... 35.2%
4. Freedom of research..... 31.4%
5. Economic advantages: salary, leave, retirement and vacations..... 17.3%

ESPECIALLY DISLIKED ASPECTS OF THE LAST GOVERNMENT POSITION

1. Dissatisfied with the administration of the various "housekeeping" functions 37.8%
2. Incompetent, inconsiderate, or undesirable supervisors and co-workers... 26.7%
3. Dissatisfied with administration of technical program 21.0%
4. Dissatisfied with economic advancement, security, and remuneration.... 15.6%
5. Dissatisfied with the type of work being done 15.2%

Section I of the report gives a summary of the findings and Section II discusses these findings in some detail. The report should be the basis of formulating important remedial measures.

CHAMBERLAIN, KATHERINE. *An Introduction to the Science of Photography.* New York: The Macmillan Company, 1951. 292 p. $4.75.

Although photography is said to be America's greatest hobby based on the number of people participating one way or another, relatively few textbooks are available for beginners' courses in photography. Relatively few schools—college or secondary—offer courses in photography, and desirable textbooks for these are said to be relatively few. *An Introduction to the Science of Photography* is designed to meet that need. It will also serve equally well for those not enrolled in formal courses. Nearly every phase of photography is covered. There are questions and problems at the end of each chapter together with suggested additional reading material. At the end of the text are seven plates of unusual interest depicting some principles of composition.

HUNTINGTON, ELLSWORTH, AND SHAW, EARL B. *Principles of Human Geography.* New York: John Wiley and Sons, Inc., 1951. 805 p. $6.25.

This is the sixth edition of the late Ellsworth Huntington's *Principles of Human Geography,* published in 1920 and based on original work in collaboration with the late Sumner W. Cushing. The reviewer used this first edition as a text and has always considered it one of the most outstanding textbooks in any field. Few writers in any field and even fewer in geography have had the ability to write as interestingly and as authoritatively as Ellsworth Huntington. America has produced few if any superiors in geography to Ellsworth Huntington. His *Civili-*

zation and Climate, The Pulse of Asia, The Human Habitat, and *Mainsprings of Civilization* as a group are unequalled in all geographic literature.

This revision by Earl B. Shaw retains much of the vitalizing freshness and interest of the Huntington books. Professor Shaw is to be congratulated on a task especially well done. Here's a text that has a literary style that so few college textbooks possess—unfortunately so for thousands of college students.

Well written, excellent illustrations, challenging material, a most readable literary style, excellent paper composition, and fine general appearance all combine to make this one of the finest college textbooks that the reviewer has chanced across in a long time.

WEIMER, BERNAL R. *Man and the Animal World.* New York: John Wiley & Sons, Inc., 1951. 569 p. $4.00.

Man and the Animal World seems to be a most excellent textbook in college biology. The organisms of the animal world are treated as dynamic living entities. The book follows the time tested principle of starting with something the reader already knows and then proceeds to what he doesn't know. There is a strong human appeal throughout the book. There are 315 helpful drawings and photographs and 16 color plates. The content seems to be well-selected. The author is professor of biology at Bethany College, Bethany, West Virginia.

Not only would the book serve as an excellent text in college biology, but also as a reference for the high school biology teacher.

GARRETT, ALFRED BENJAMIN, HASKINS, JOSEPH KEDERIC, AND SISLER, HARRY HALL. *Essentials of Chemistry.* Boston: Ginn and Company, 1951. 570 p. $5.00.

At long last here is a college chemistry text that is similar to the better high school chemistry texts of today. It is rather difficult to understand why college chemistry textbook writers have so long delayed to write a textbook that has the psychological appeal of high school texts—literary style, psychologically arranged, more attractive and pertinent photographs and illustrations, and more attention to such study aids as visual aids, learning aids and supplementary readings. One of the most important departures is the organization into units. Other texts have had unit organization but more as a matter of form rather than in spirit. In fact this book could be readily used with better high school students. Units are: The Materials of Which the World Is Made; The Components of the Atmosphere; The States of Matter; The Material of the Earth's Crust; Radioactivity and Atomic Structure; The Periodic System; The Families of Elements; Organic Chemistry: The Chemistry of the Compounds of Carbon; and The Chemistry of Everyday Life.

The authors are professors of Chemistry at the Ohio State University. Altogether the reviewer considers this book as ranking highest in student appeal and reading interest of any college chemistry textbook that he has chanced across. It should prove to be one of the most popular of all college texts for many years to come.

GARRETT, ALFRED BENJAMIN, HASKINS, JOSEPH FREDERIC, SISLER, HARRY HALL, AND KURBATOO, MARGARET H. *Essentials of Experimental Chemistry.* Boston: Ginn and Company, 1951. 326 p. $2.80.

This is a laboratory and demonstration manual intended to accompany the authors' *Essentials of Chemistry* reviewed above. It should serve the dual purpose of a laboratory workbook and a lecture demonstration notebook. It is of the looseleaf, detachable, fill-in blank type. There are a total of seventy-three exercises emphasizing the practical approach used in the text.

POSTL, ANTON. *Laboratory Experiments in Physical Science.* Minneapolis, Minnesota (426 South Sixth Street): Burgess Publishing Company, 1951. 72 p. $1.50.

Few laboratory manuals for college physical science survey courses have been published. On the other hand, many colleges (probably a large majority) do offer student laboratory work in connection with their physical science survey courses. The list of experiments is not exhaustive and offers little choice for selection except by addition. Possibly the list will be sufficient for many survey courses. There are 2 experiments in astronomy, six in chemistry, six in geology, two in meteorology, and ten in physics.

YOUNG, CLARENCE W., AND STEBBINS, G. LEDYARD. *The Human Organism and the World of Life.* New York: Harper & Brothers, 1951. 897 p. $6.00.

This is a complete revision of a book first published in 1938. Since the first edition more than 200 colleges have used the book. The human organism receives more than the usual emphasis. In the new edition the subject matter has been completely reorganized and radically modified. Scientific method receives increased emphasis. Many new drawings and photographs have been added.

Altogether the revised edition is a most attractive, readable book. It will serve excellently as either a text or as a reference book.

WOODRUFF, LORANDE LOSS, AND BAITSELL, GEORGE ALFRED. *Foundations of Biology.* New York: The Macmillan Company, 1951. 719 p. $5.50.

This is the seventh edition of a book first published in 1922. It has been a very popular

book ever since the first edition. Material has been brought up to date and some of the chapters have been rearranged. Six new chapters have been added. In the appendix there is a bibliography for each chapter, a glossary of definitions, and a synoptic classification of plants and animals.

Stanford, E. E. *Man and the Living World.* New York: The Macmillan Company, 1951. 863 p. $5.50.

This is the second edition of a book first printed in 1940. This new edition brings the content up-to-date and affords some shifts in emphasis and arrangement. The book is intended as the basic text in course in elementary biology. Practical aspects receive more than normal emphasis. Survey courses in biology could use it either as the main text or for supplementary reading. It would serve the general science and high school biology teacher as a most useful reference.

Hegner, Robert W., and Stiles, Karl A. *College Zoology.* New York: The Macmillan Company, 1951. 911 p. $6.00.

This is the sixth edition of a book first published in 1912. The late Dr. Hegner was one of America's foremost zoologists. The first editions of the text book were widely used and constituted an outstanding contribution to American science teaching. Dr. Stiles has revised the older editions, brought material up to date, rearranged some content, and has *added* more than 300 new illustrations. This book is not only an excellent college text in zoology but an excellent reference for high school biology and general science teachers, or the elementary science teacher.

Buchanan, Robert E., and Buchanan, Estelle D. *Bacteriology.* New York: The Macmillan Company, 1951. 678 p. $6.00.

This is the fifth edition of a textbook first published in 1913. The great advances in the field of bacteriology in recent years are adequately taken into account in this new edition. The numerous teachers of the previous editions will greatly appreciate the opportunity of having this up-to-date revision.

Headquarters Staff of the American Radio Relay League. *The Radio Amateur's Handbook.* West Hartford, Connecticut: The American Radio Relay League, 1951. 551+v, 57+120 p. $2.50.

This is the twenty-eighth edition of the world's most famous radio handbook. It is brought up to date each year and seems to completely cover every aspect of radio that amateurs are likely to want to know about. The circulation of this book is said to be well over two million—a wonderful growth since the first edition in 1926.

The amateur's code by Paul M. Segal, page eight, might well be that of every science student: (1) The amateur is gentlemanly; (2) the amateur is loyal; (3) the amateur is progressive; (4) the amateur is friendly; (5) the amateur is balanced; and (6) the amateur is patriotic.

Eaton, J. Theodore H. *Comparative Anatomy of the Vertebrates.* New York: Harper and Brothers, 1951. 340 p. $4.00.

This is a concise, fully illustrated (322 illustrations) text for introductory courses in comparative anatomy, presenting a clear-cut picture of the chordates and their ways of life. The author is professor of zoology at East Carolina College, Greenville, North Carolina.

The President's Water Resources Policy Commission. *Volume 1: A Water Policy for the American People; Volume 2: Ten Rivers in America's Future.* Washington, D. C.: Superintendent of Documents, 1951. 445 p.; 801 p.

These two volumes are part of a three-volume report of the President's Water Resources Policy Commission. Volume 1 gives a summary of the recommendations and discusses: regional development, national objectives, unity in planning, evaluation, reimbursement, a resources investment program, the need for basic information, surface and ground water, watershed management, flood management, land reclamation, domestic and industrial water supply, pollution control, inland and intracoastal waterways, hydroelectric power, recreation, fish and wildlife, conservation education, and legal aspects.

Volume 2 describes the large river systems of the United States: The Columbia, Missouri, Rio Grande, Connecticut, Alabama-Coosa, Potomac, Colorado, Tennessee, Ohio, and Central California. Much information valuable for conservation education is included. There are numerous charts and graphs.

Leach, H. W., and Beakley, George C. *Elementary Problems in Engineering.* New York: The Macmillan Company, 1951. 269 p. $3.50.

The text was written for use in engineering problems courses. All problems and explanations have been prepared on the assumption that most problems courses are offered in the freshman year. An attempt has been made to make the book as practical and stimulating as possible.

Meyer, Lillian Hoagland. *Introductory Chemistry.* New York: The Macmillan Company, 1951. 532 p. $5.00.

Introductory Chemistry is a college textbook designed for students of Home Economics and Applied Biological Sciences. The author is professor of chemistry at Western Michigan College of Education. Through teaching chemistry as well as nutrition to home economics student the author realized that most home economics students take only one year of chemistry and that they need some knowledge of organic chemistry in

the study of foods, nutrition, and textiles. The author devotes most of the second semester to the study of organic chemistry, biochemistry, and textile chemistry. Applications are stressed. Altogether it seems to be an unusually good book in first year college chemistry, and it is *different*. High school chemistry teachers desiring a more functional approach will find the text an excellent reference.

HOLMES, HARRY N. *Introductory College Chemistry.* New York: The Macmillan Company, 1951. 594 p. $4.75.

This is the fifth edition of a book first published in 1925. The author, professor of Chemistry at Oberlin College, is one of America's better known chemists. In the preface he states that this is a somewhat more radical revision than usual, bringing it into line with present concepts of teaching chemistry. More emphasis is placed on the size and structure of the atom. The early preliminary treatment of atomic structure is developed more fully. Atomic energy and fission are given much more extended treatment.

FELSING, WILLIAM A. *General Chemistry.* New York: McGraw-Hill Book Company, 1951. 558 p. $5.00.

This is the third edition of a book first published in 1938. Primary emphasis is placed on *chemical principles.* A definite attempt is made to obtain better correlation of laboratory and classroom work.

NOLLER, CARL R. *Chemistry of Organic Compounds.* Philadelphia: W. B. Saunders Company. 1951. 885 p.

While as much of the present new theories regarding the electronic structure of organic compounds are included as possible, yet the author has been mindful of the learning difficulties of beginners in organic chemistry. Hence he has taken a sort of middle of the road presentation. This book seems to be most complete and comprehensive. Any student approaching a mastery of this text will have a very good foundation in organic chemistry.

NOLL, VICTOR H. (Coordinator for Science Tests); ANDERSON, KENNETH E. *Anderson Chemistry Test;* DUNNING, GORDON M. *Dunning Physics Test;* NELSON, CLARENCE H. *Nelson Biology Test;* READ, JOHN G. *Read General Science Test.* Yonkers, New York: World Book Company, 1951. $0.35 for specimen set.

The above tests in chemistry, physics, biology, and general science are part of the *Evaluation and Adjustment Series* of high school tests designed to measure objectives of present-day high school instruction with the best of present-day testing techniques. The nature of the series is such as to make possible a uniform coordinated program of evaluation in many important areas of secondary education.

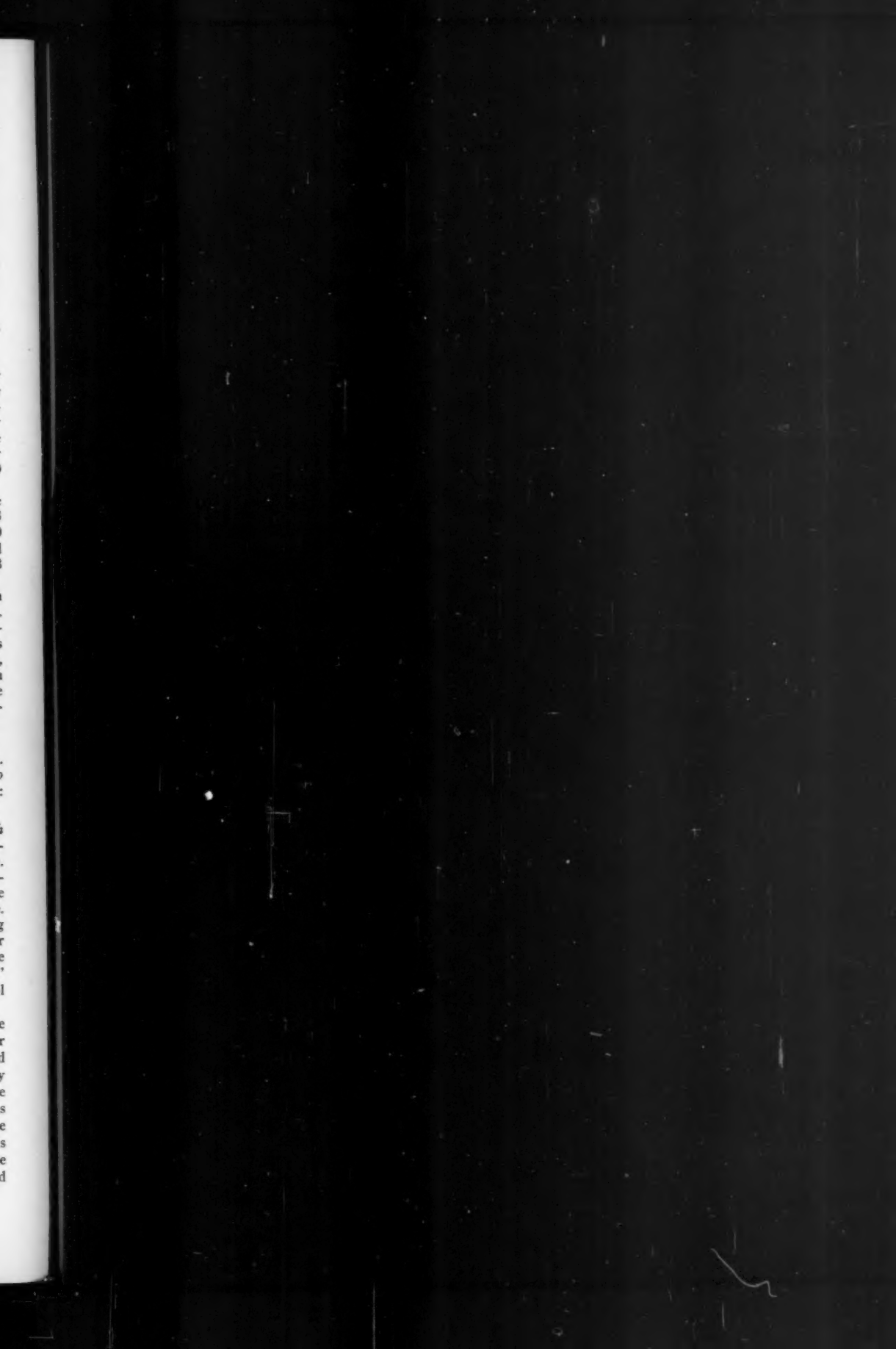
The content of each test is based on extensive study of contemporary textbooks, courses of study, and professional literature. All tests have been standardized on widely representative groups of high school students. Standard scores on each test are equated to intelligence test scores of the standardization population, thus permitting direct comparison of achievement with mental ability.

All test items are of completely objective type. The science tests each have 75 multiple choice items. There are two forms for each science test: Forms Am and Bm. A manual of directions, key, class record, and answer sheet for machine scoring accompany each test. Percentile norms and item-difficulty values are given for each test. Working time for each test is 40 minutes.

The reliability coefficient for each form of the Anderson Chemistry Test is given as .90 and .93 respectively; for the Dunning Physics Test .90 and .86; for the Nelson Biology Test .87 and .88; and for the Read General Science Test .88 and .85.

Dr. Victor H. Noll is Professor of Education at Michigan State College. Dr. Kenneth E. Anderson is Professor of Education at the University of Kansas. Dr. Gordon M. Dunning is Professor at Indiana State Teachers College, Indiana, Pennsylvania. Dr. Clarence H. Nelson is on the Board of Examiners at Michigan State College. Dr. John G. Read is Professor of Education at Boston University.

BLOUGH, GLENN O., AND HUGGETT, ALBERT J. *Elementary School Science and How to Teach It.* New York (31 West 54th Street): The Dryden Press, 1951. 532 p. $5.25.

Elementary School Science and How to Teach It is a companion book to *Methods and Activities in Elementary School Science* reviewed above. This book is for courses which combine teaching methods with science subject-matter. The first five chapters in each text are the same. Chapters "B" in this text have a corresponding similar chapter in the first book. Each chapter "A" in this book deals with subject-matter. The "B" chapter shows how the content of "A" chapter can be taught in the elementary school classroom.

The two books afford the elementary science methods teacher with choices probably never before available—combining both content and method, or a method course based on previously learned content. Many teachers may prefer the combination book, especially if their previous science work has been in the usual pure-science content courses where not the least reference is ever made to professionalization. At any rate the two books are most outstanding in method and in combined method and content.